ELEMENTARY HYGIENE
FOR INDIA

BY

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SIXTH EDITION

(Largely Re-written)

"Filth is the mother of sickness"

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*"How muchsoever you may study science
If you do not act wisely you are ignorant"*

(Gulistan)

S. K. LAHIRI AND CO.
COLLEGE STREET, CALCUTTA

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PREFACE TO FOURTH EDITION.

The publishers having asked me to prepare a fourth edition of this small book, I have taken the opportunity to rewrite some portions of it and to remove parts of more or less academic interest, the insertion of which in previous editions was required by adherence to the official syllabus prescribed by the Calcutta University for Hygiene for the First Arts' Examination. This syllabus has ceased to exist officially but I decided still to adhere to it, in great measure, as being well adapted for the present purpose. The requirements of examinations in Elementary Hygiene have, however, been kept in view throughout the book.

I need perhaps hardly apologise for the simple language and the repetitions in the text, which seem to me requisite in an elementary book of this kind, written for students often with no very extensive knowledge of English. I have borne in mind, as regards these repetitions of teaching, the words of Herbert Spencer: "It is only by varied iteration that alien conceptions can be forced on reluctant minds."

The extracts from the Sacred Books of India have been retained in this edition also in order to fortify the advice given.

LONDON, CHARLES H. BEDFORD.
1918.

CHAPTER I.

INTRODUCTORY

Meaning of the terms Sanitation and Hygiene :

Sanitation or Hygiene* are names used for that branch of knowledge which studies the Laws of Health.

The Laws of Health are rules which have been learnt by experience and study of the means by which we may keep our bodies well and strong.

Object in view in studying these subjects :

It is everyone's first duty to take the best care he can of his health ; not only for his own sake but for that of others as well. We never understand fully how good a thing health is until we are ill.

The object, then, of Sanitary Science, or Hygiene, is to study the causes of diseases and to take steps to prevent diseases. It aims at keeping people in perfect health in mind and body.

In order to know how to keep the body well and strong it is necessary first to understand the way in which it naturally carries on its duties. In the next chapter certain facts will be stated with which we must be acquainted in order to understand how the body carries on its duties in health.

Besides we must know how to make our surroundings as health-giving as we possibly can. And also we must consider what foods and drinks we ought to take or to avoid in order to keep well.

**Sanitation* is derived from the Latin word *sanitas* which means a state of health.

Hygiene is derived from the Greek *Hygeia*, the goddess of Health.

Sanitary Science or Hygiene may be divided into two great divisions—Public Health and Personal Health.

Public Health is the study of how *to guard the Health of the Public in general.*

The best Government in the world cannot make a people healthy unless the people themselves help. The people must understand the dangers they run in living in unhealthy ways and must get to know that most diseases can be prevented by taking care as to certain matters. When they see how this can be done they will, in self-defence, help Government to prevent disease and to help them to live in more healthy surroundings.

Both for our own sake, and for that of our neighbours as well, we ought to learn how to take our share in preventing the spread of disease—

> " The little-minded ask ' Belongs this man to our own family ?'
> The noble-hearted regard the human race as all akin."
> (*Panchatantra*)

It must be remembered that it is not sufficient to *know* what is the right thing to do. We must do it. The writer knows of a case in which a learned Indian gentleman—Principal of an Indian College—was a profound admirer of Sanitary Science (in theory). He used, however, to sit and study at a window which was just above a foul drain. He did not act on the advice given in the *Apastamba,*—" a foul smell is a reason for the discontinuance of study." He died of being poisoned by his insanitary surroundings. Can anything be more foolish than to know what is good for us and then to be too lazy to do it ? Prejudice, ignorance and the force of bad habits got by living in filthy and insanitary surroundings are the cause of very many thousands of deaths every year in India as elsewhere.

There is nothing in Sanitary Science which is contrary to the teachings of any religion. On the contrary all great religious teachers—Christ, Muhammad, the Buddha, and the Hindu holy men—insist on sanitary precautions being taken. Many religious ceremonies—fasts and purifications—were ordered by the founders of religions as they knew that "Cleanliness is next to godliness." A man who is living in a healthy manner has more self-respect and he is more able to make himself a better man in every way—body and soul. Remember that a sound mind cannot well exist in an unsound and unhealthy body. People who live crowded up in filthy and insanitary houses always tend to become worse in body, mind and morals than those who refuse to let themselves be thus slowly degraded and even killed by their unhealthy surroundings.

Public Health, then, is concerned with taking care of the health of the inhabitants of a place. It is necessary to take special care as regards the following :—

1. Our Houses—how they are built and arranged ; prevention of over-crowding, etc.

2. The Water-supply.

3. The Food-supply.

4. The removal of the solid and liquid excretions of the inhabitants.

5. Cleanliness of the streets and removal of refuse matter.

6. The prevention and arrest of Infectious Diseases.

7. Disposal of Dead Bodies.

8. Regulation of Trades so that the inhabitants may not suffer in health from offensive smells, smoke, fumes, etc.

Every intelligent man should use his influence to get rid of any unhealthy condition existing in his town and *the least* he can do is to take care that his own house is kept in a

sanitary state and does not endanger his own or his neighbour's health.

Personal Hygiene or Health—As there are Public Laws for the preservation of health so there are rules for living healthily—or " good habits of life "—which if followed will keep the individual well. It is Personal Hygiene that teaches the individual how to keep his body in health by paying attention to the following points:

1. Diet.
2. Exercise and Rest—of Body and Mind.
3. Sleep.
4. Clothing.
5. Cleanliness.
6. Regulation of the Passions.

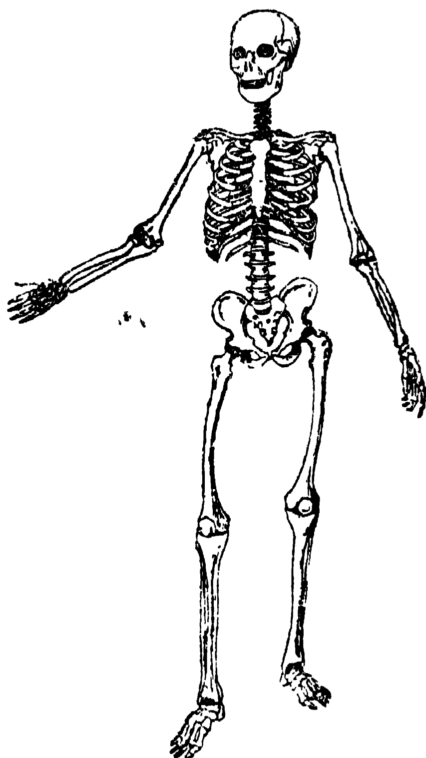
Also by attention to what may be called **Domestic Hygiene,** which deals with:—

1. Ventilation of the House.
2. Removal of the Refuse and Excretions from the House.
3. Storage and use of water in the House.
4. Cleanliness of the House.
5. Storage of Food in the House, Cooking, etc.
6. Lighting and Warming or Cooling of the House.
7. Care of the Site and Surroundings of the House.

CHAPTER II.

GENERAL FUNCTIONS OF THE BODY

The body may be considered as made up of the Head, the Trunk, and the Limbs (the Arms and Legs).



The Trunk is composed of (1) the spine or vertebral column which consists of a number of small bones arranged one above the other and called *vertebræ*. These bones move readily on one another and so the spine can be bent in different directions at will. It contains in a canal in its centre the spinal cord—a very important nervous structure.

(2) *The Chest or Thorax* is formed by a portion of the spine behind; by the ribs—twelve at each side; and by the breast-bone (or sternum) in front. It contains:

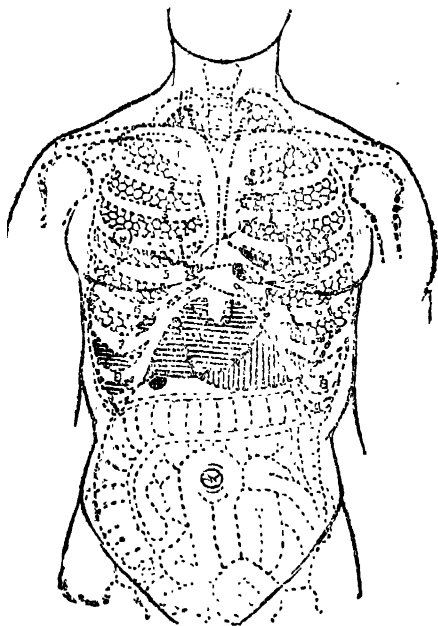
(*a*) The Heart and several great blood vessels; and

(*b*) The Lungs and Bronchial tubes;

(*c*) The Œsophagus or Gullet, a tube leading from the mouth to the stomach.

(3) *The Belly or Abdomen* is below the chest and is separated from it by a membrane called the Midriff or Diaphragm. The abdomen has behind, a portion of the spine and the loin muscles: at the sides (or flanks) and in front the muscles of the Belly wall: and below, the bony basin known as the Pelvis.

The abdomen contains the stomach and intestines, the liver, spleen, pancreas, kidneys and, in the pelvis, the urinary bladder.

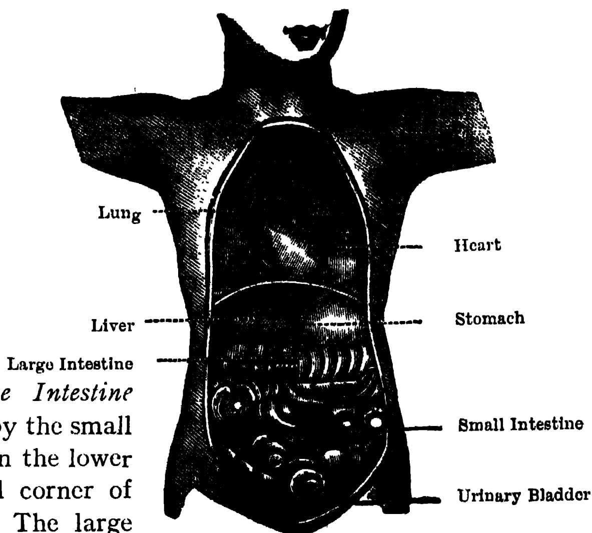


The stomach lies partly under the left lower ribs and within that part of the belly popularly known as the "pit of the stomach." It lies close to the inner surface of the belly-wall, in front.

The stomach is a bag into which the food passes on being swallowed. It has two openings into it—one (the Cardiac Orifice) by which the food enters from the gullet and a second opening (called the Pylorus) by which the food leaves the stomach and passes into the bowel or intestine. The stomach, then, discharges its contents into the *Small Intestine* which is at this part called the

Duodenum. This portion is about 12 inches long and forms a loop downwards and then to the left, and then ends in the second part of the small intestine known as the Jejunum which is joined to the third and chief part of the small intestine which is known as the Ileum.

The small intestine ends by opening into the large intestine. At the opening there is a valve called the *ileo-cæcal valve* which allows food to pass from the small intestine into the large but prevents food from getting back from the large intestine into the small intestine again.



The Large Intestine is joined by the small intestine in the lower right-hand corner of the belly. The large intestine then passes upwards to a point under the lower ribs, just below the liver. It then curves across the belly, lying just below the stomach. Then under the left lower ribs it bends downwards and finally ends in a straight piece (called the Rectum) which opens to the exterior of the body by the Anus or opening of the Bowel.

The liver mostly lies in the right upper portion of the belly under the ribs but is also prolonged over to the left

side of the belly, lying above the stomach. On the lower surface of the liver is a small bag for storing the Gall or Bile and therefore called the Gall-bladder. This bladder opens into the Duodenum by a pipe or duct through which the Bile flows to mix with the contents of the Bowel.

The Pancreas is a gland (that is an organ for making a fluid or *secretion*) lying behind the stomach and in the loop or bend of the Duodenum.

The Spleen is another gland lying on the left side of the belly, *behind the stomach*, and touching the ribs.

The Kidneys lie one on either side of the spine which they touch. They are situated lower than the Liver and Spleen.

The Urinary Bladder lies in the Pelvis or bony basin at the lower part of the Belly. It lies in front of the Rectum or straight end-piece of the Large Intestine.

Digestion.—Let us follow what happens to the food after it has been eaten.

The food is first chewed (or divided up finely) by the teeth and while this is being done the " water of the mouth " or *saliva* is mixed with it. (The chewing is called Mastication and the mixing with saliva is called Insalivation).

In the mouth, then, the food is:

1. Moistened and made easy to swallow.
2. Its sugary and salt portions are dissolved.*
3. The starchy portion of the food is changed into sugar, as sugar passes much more easily into the blood from the stomach and bowels than starch does. This changing of starch into sugar is brought about by the action of a special sub-

*"Dissolved" means that these substances are taken up by the fluids just as when a little salt is placed in water it disappears. It has been "melted," so to speak, and is now mixed with the water so finely as to be part of the water for the time being.

stance called a *ferment*. (The ferment present in the saliva is called *ptyalin*). It acts best when the saliva is of a faintly alkaline reaction or neutral.* It ceases to act in the presence of an acid.

4. The food is then gathered into a soft mass (or *bolus*) and swallowed.

It passes along the gullet or œsophagus and enters the stomach by the opening called the *cardiac orifice*. It will be remembered that the other opening of the stomach was into the duodenum and is called the Pylorus. This opening, the pylorus, closes when food enters the stomach and does not open until the food has been enough digested by the stomach for it to pass on to the next stage of digestion in the intestine.

In the stomach the food meets a digestive fluid poured out by the glands in the lining membrane of the wall of the stomach. This fluid is called *gastric juice*, which contains a ferment known as pepsin and also hydrochloric (or muriatic) acid. It has a sour taste and curdles milk when mixed with it.

The action of the gastric juice on the food is :—

1. To change the albuminous† (or *proteid*) portion of the food into a form which dissolves more easily and which will pass more easily through the walls of the stomach and intestines. The proteids are therefore changed into another form called *peptones*. A large amount of the peptones passes through the walls of the stomach into the blood. The rest is absorbed by the small intestine. Sugars and salts are also absorbed by the stomach.

2. The acid of the gastric juice mixes with the saliva

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*Acid (or sour) is the opposite of alkaline. When acid and alkaline substances are mixed together in proper amount the mixture becomes *neutral*—that is, neither acid nor alkaline.

†Albuminous foods are, for example, eggs, lean butcher's meat, curd of milk, &c.

which has been swallowed along with the food and makes it acid like itself. We saw that the saliva's ferment (ptyalin) could not act when the fluid was acid, so the starch is no longer acted on by it when in the stomach. *Thus the gastric juice has practically no action on the starchy part of the food.*

But, after the food is swallowed, it is sometime before the acid is able fully to act on the alkaline saliva so that starch goes on being turned into sugar for sometime after it reaches the stomach.

3. The acid in the gastric juice partly prevents putrefaction of the food swallowed. This action is not, however, a powerful one and does not kill all disease-germs swallowed along with food. (Thus tubercle or consumption-germs in milk may not be killed in the stomach).

The stomach acts as a temporary store-house for food. Thus we are able to take a quantity of food at one time, that is to "make a meal."

The adult's stomach can hold usually about two pounds of solid food *or* from two to four pints of fluid. Most people eat about three pounds of solid food in a day. Thus it is scarcely possible to take all our food at one meal without greatly overloading the stomach. Two moderate-sized meals a day are usually enough. But it is the quantity eaten during the day that matters and, so long as this is sufficient and not excessive, it does not matter whether it is taken in two or in three meals.

The stomach warms up the food to make it of the right heat to pass on to the intestines. Food taken at the same heat as the body is found to stay the least time in the stomach. If food is swallowed too cold it may give rise to irritation and cause diarrhœa.

The *fats* of the food are only melted by the heat of the stomach and churned by its movements, for the stomach during digestion is always squeezing the food in it so as to

mix it up thoroughly. This the stomach does by means of the muscles in its walls.

When the food has remained in the stomach sufficiently long and has been sufficiently churned up it becomes changed into a thick half-fluid mass and this is called the *chyme.* The chyme passes on into the duodenum through the Pylorus and in the intestines it is acted on by three more digestive juices, namely :

1. *The Bile* which is a brownish or greenish fluid. About 40 ounces daily are made by the Liver. It acts on the food mainly by

(*a*) breaking up the fat into smaller particles or drops. This makes it easier for the fat to pass through the intestinal walls into the blood.

(*b*) It also prevents the food from becoming too soon putrid. It has, in other words, a mild *antiseptic* action.

(*c*) Many substances of a more or less poisonous nature are produced in the body. The liver removes these from the blood and gets rid of them by the bile.

(*d*) The bile is also believed to act as a natural purgative, thus keeping the action of the bowels regular, and helping further to purify the body.

The Liver besides making bile also converts the starchy part of the food into *animal* starch or glycogen. This glycogen afterwards becomes converted into a form of sugar which is mainly used for supplying energy to the muscles and for keeping up the body's heat.

2. *The Pancreatic Juice* is poured out by the Pancreas through its duct into the Duodenum. This Juice is watery and is *alkaline*—that is, like the saliva and unlike the gastric juice. The Pancreatic Juice has three ferments : one (called Trypsin) which acts like the stomach ferment, pepsin, and changes proteids into peptones ; another (called Steapsin) which *breaks up the fats of the food* into very small drops (this is called " emulsifying " the fats) ; and a third (called

Amylopsin) which acts like the Ptyalin of the saliva and changes starches into sugars.

3. *The Intestinal Jiuce* is the last digestive juice which acts on the food. It is poured out by the glands in the lining membrane of the small intestine. It acts in the same three ways as the Pancreatic Juice.

When the food passes from the stomach it is in the form of turbid chyme. It meets the bile, pancreatic and intestinal juices and it is then called *Chyle*, which is a fluid looking somewhat like cream. This chyle passes through the walls of the intestine into the blood which is flowing in the small blood-vessels which run in the walls of the intestine. To increase the amount of absorbing surface there are very small finger-like processes called *villi*. Each of these has in it blood-vessels and lacteal vessels into which the food is absorbed. (The lacteal vessels are called so from the Latin word meaning milk, fcr the fluid they contain looks somewhat like milk). Those portions of the food which cannot be digested at all are pushed onwards by the muscles in the walls of the intestine and finally reach the end of the intestine. This motion is called peristaltic or vermicular* because it looks like the movements of an earth-worm. Grasp anything in the hand and then squeeze it out and you will understand how the intestines squeeze along the food until it has been all taken up by the blood or the undigested portion has been discharged from the opening of the bowel in the form of *fæces* (" stools " or " motions " as this excretion is popularly termed).

An average-sized meal has passed out of the stomach in about four to five hours.† It passes through the small intestine in about the same time. Its passage along the

*From the Latin word, *vermis*, a worm.
†See Appendix III.

large intestine takes very much longer,—twenty-four hours or even longer.

Now let us see what practical lessons we may learn from the above as to how best to use our digestive functions.

Mouth.

1. *The food must be thoroughly well chewed and mixed with the saliva.* Eat slowly. Do not swallow food in large lumps. *The food must be chewed until it is as fluid as possible.* Unless small mouthfuls of food are taken it is difficult to do this properly. Again, if the teeth are bad and cause pain on biting hard food, this chewing can never be well done. Where many teeth have been lost by disease and rotting the dentist can replace them by false teeth which are not made from human teeth but are made from mineral substances to look exactly the same as real human teeth. A great deal of trouble can be saved by having the rotten portion of the tooth scraped out by the dentist and filled with metal or a kind of cement "stopping." The tooth so treated then keeps fit for its work and lasts a long time.

2. The mouth must be kept clean and the teeth should be cleansed every morning and every night by washing with a tooth-brush or piece of soft clean rag. A piece of soft wood is used for this purpose by most Indians. Special tooth-brushes are made for orthodox Hindus. India-rubber tooth-brushes are much used. As they contain no animal matter, Hindus can have no objection to use them. Ordinary tooth-brushes are made of bristles or hair.

A little soap should be robbed on the brush or rag first as this keeps the teeth cleaner. Great care should be taken to clean between the teeth, as food collects there and will rot the teeth. It is a good plan to clean between the teeth by passing a piece of clean string between them and gently drawing it back and forwards.

If the mouth is not kept clean the breath becomes foul-

smelling, the teeth rot and give pain and require removal and indigestion (or difficulty in digesting the food) follows. Also, where the gums become unhealthy, " matter " or pus forms under the gums and sets up serious poisoning of the whole body. It is very common (both among Europeans and Indians) for the gums to be affected with this condition (known as "pyorrhœa alveolaris"). Pus can then be squeezed from the gums by pressing on them above the teeth. The result of this condition is constant ill-health from swallowing the pus and also by directly absorbing it from the gums into the system. The teeth so affected finally loosen so much as to have to be removed.

This disease causes many remote diseases of rheumatic and other forms.

As regards digestion in the stomach and intestines remember that :

1. Food or drink must not be taken too hot or too cold. Taking large quantities of iced drink or eating much iced food is bad for digestion. The stomach will not work properly if there is much cold food or fluid in it for the cold prevents the pepsin from acting, and also partly drives the blood out of the walls of the stomach and so lessons the amount of gastric juice poured out. So avoid taking *large quantities* of very cold fluid along with meals. Many people may continue to take iced fluids with meals with apparently no great harm. But all the same this practice undoubtedly tends to weaken and considerably delay digestion.

2. As little fluid as possible should be taken with food.* It is best to take fluid about an hour before meals or, if this cannot well be done, then a little time after the meal is finished. The reason of this is that water does not pass through the walls of the stomach but is kept in the stomach

*If fluid is craved during a meal, it ought to be taken, in small amount only, towards the end of the meal.

and passed into the duodenum later. If then, *too much* fluid is taken with food the gastric juice becomes so weak that it cannot properly perform its digestive work. This mistake is very frequently made and much indigestion results from this.

3. Too much fatty or sugary food should not be taken as the stomach's contents will turn too sour, and this will hinder and upset digestion. Fats (if taken in excess) delay digestion by covering up particles of food so that the digestive juices cannot reach them.

4. Food should be taken at regular intervals. The stomach and bowels require time to digest the last meal and an ordinary moderate-sized meal does not pass out of the stomach until about four hours after it is taken. So the stomach needs a short rest before again being exercised. We may lay down the general rule that meals should be taken at intervals of not less than about five hours.*

5. It is a mistake to go to sleep very soon after a large meal. Digestion is somewhat interfered with as much of the blood is drained off from the stomach to the skin when a person falls asleep. The gastric and other digestive glands have therefore not enough blood from which to make the digestive juices. Hence indigestion often results.

6. No violent exercise should be taken till at least 30 or 40 minutes after a large meal. By exercise the blood is drawn away to the muscles and skin and the result is that there is not enough left in the blood vessels of the stomach and bowels to make a sufficient quantity of the digestive juices. Besides, the nervous energy needed to carry on digestion properly is used up by the muscles of the limbs, etc.

7. After violent exercise or if you are tired, rest for half an hour before taking a meal. If you do not, the digestive

*See Appendix III for rates of digestion of various foods by the stomach.

apparatus is tired as well as the rest of your body and cannot perform its functions properly.

8. Do not read or study while eating a meal. If you do you are very apt to forget to chew your food properly and are apt to bolt it. Besides reading takes blood and energy away from the stomach to the brain and thus lessens the amount of the digestive juice. Pleasant conversation or listening to music during meal times aids digestion.

9. *Never go on eating after you begin to feel satisfied. Be strictly moderate in the amounts of food and drink you take.* No rule is more important than this.

10. Do not eat between your regular meal times. The stomach for 3 or 4 hours or even longer after a meal is busy digesting it. If you swallow fresh food before the last meal has left the stomach you delay digestion and very often so seriously interfere with it as to cause indigestion.

11. After a meal, do not sit so as to double up the belly in any way, for this interferes with the peristaltic action of the stomach and intestines. Sit as erect as possible for some time after a meal. (Or, *if you suffer from weak digestion,* lie flat on your back or on your right side for half an hour or an hour after a meal.)

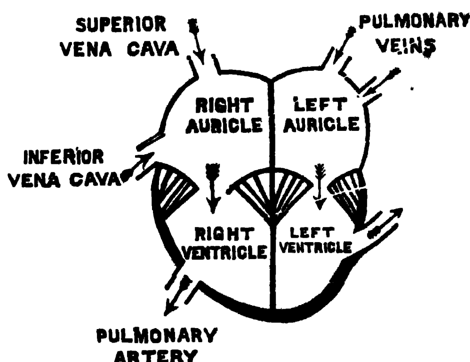
12. *Never eat unless you feel hungry,—that is, when your mouth waters at the sight or thought of food.*

Circulation of the blood.* The heart is a hollow bag the sides of which are composed of muscles which, at regular intervals, contract and squeeze out the blood lying inside it.

The heart is like a four-roomed house divided into two portions—two rooms above and two below but only one room above opening into one room below. The following diagram will show this readily.

***A grown-up person's heart beats about 70 times a minute and he breathes about 20 times a minute—when in health.**

The impure blood is collected from all parts of the body by two big veins (called the superior and inferior Venæ Cavæ) and is poured into the right auricle.



When the right auricle is full its walls contract and drive the blood down into the right ventricle through a hole which can be completely closed by three curtains or valves. These valves allow the blood to be forced down past them into the right ventricle which as it fills with blood floats the three valves up till they meet and close. The valves cannot be pushed into the auricle because as they close some strings which are fixed to their lower surfaces are stretched and keep the valves from being forced up into the auricle.

The right ventricle being full then contracts and drives the impure *venous* blood through the pulmonary arteries to the Lungs. The pulmonary artery (at its opening into the right ventricle) has three valves to prevent the fluid flowing back into the heart again. The blood is forced through the Lungs and is purified by the air it meets there.

The purified blood then is collected and sent back to the left side of the Heart by the Pulmonary Veins.*

The purified blood flows into the left auricle which when full contracts. The blood is then driven into the left ventricle through an aperture provided with two valves

***The pulmonary veins are the only veins in the body which carry pure or arterial blood. All other veins carry venous or impure blood.**

(mitral valves) which are of the same form as those in the right ventricle.

When the left ventricle is full its walls contract and the blood is forced through the largest artery in the body (called the aorta) to all parts of the body. The opening of the aorta is like the opening of the pulmonary artery in having three little valves which come together and prevent the blood flowing back into the heart when the ventricle has ceased to contract.

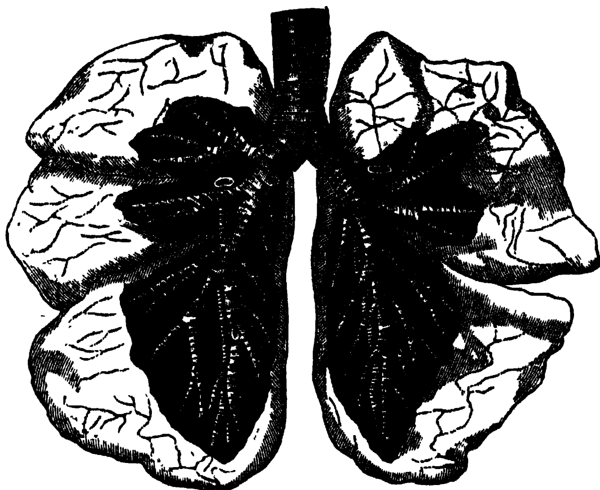
Both auricles contract at the same time and then both the ventricles contract together, and the contraction of the ventricles can be felt by placing the hand over the heart and this is known as the heart-beat.

Pure blood is bright red and flows in the arteries (hence it is called *arterial* blood). Impure blood is purplish-red and flows in the veins (hence called *venous* blood). If we put a drop of blood under a microscope and thus magnify it very much we see that it is made up of a straw coloured fluid (*serum*) in which float enormous numbers of yellowish flat cells (red blood cells or corpuscles) and a much smaller amount of white blood cells (leucocytes)—1 white to about 500 red. *The red cells* are so small that each, if measured across, is only $\frac{1}{8,200}$th part of an inch. They are only $\frac{1}{12,000}$th part of an inch thick. These red cells carry the oxygen* of the air to all parts of our body and thus purify it. *The white cells are* about $\frac{1}{2,500}$th part of an inch in diameter. They are the sweepers or scavengers of the blood. They eat up any germs or particles floating in it. They thus help to protect our bodies from injury by any disease-germs which may get into the blood. The white

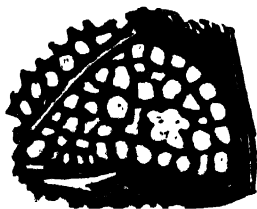
*Oxygen is a gas found in the air which purifies whatever it touches. This is called *oxidation* and heat is always given off in this process; hence a fire burns and our bodies are warmed by oxidation.

corpuscles have other functions as well but we need not trouble about these at present. Blood *clots* (or sets into a jelly-like mass) when it is exposed to the air. Were it not for this we would bleed to death whenever we cut ourselves and drew blood.

Respiration.—The air we draw into our lungs at each *inspiration* passes through the nostrils, down the back of the throat, through the wind pipe (or trachea) and then into the



lungs by the bronchial tubes which divided up into a number of smaller tubes all over the lung. At last the tubes end in what are called *air-cells* (or alveoli). Here the air is only separated from the blood by a thin membrane through which the air can readily pass and mix with the impure venous blood flowing in the small hair-like (or capillary) vessels of the lung.



The air from the air-cell passes into the blood carrying with it the life-giving gas called Oxygen. The impure blood gives up its impure gases which pass through the membrane and are then breathed out into the outer air (expiration).

Thus Respiration is carried on by the acts of inspiration and expiration. When the breath is drawn in the chest enlarges because the ribs and breast-bone are pulled up by their muscles. The two lungs then also expand and suck in the air. Then when the chest is sufficiently full of air the muscles which have lifted the ribs and breast-bone cease to act and the chest-wall falls and drives out a portion of the air in it.

The air should be breathed *in* through the nose, as this warms and cleans it before it reaches the lungs. It should be breathed *out* through the nose when breathing quietly. During violent exertion, however, the mouth is chiefly used in breathing in and out.

When taking a deep breath the lower part of the chest should chiefly move. The shoulders should not be lifted during breathing.

Deep breathing exercises are most useful and are described later on—(Appendix I). A few minutes every morning (and evening also, if possible) spent in such exercises will amply repay the trouble by the feeling of well-being which will follow this daily practice.

The air *leaving* the lungs differs from the air which was drawn into the lungs thus:—

1. The Oxygen is generally about 5 per cent less.
2. The Carbonic acid gas is about 4 per cent more.
3. It is loaded with watery vapour, or moisture.
4. It has small quantities of other gases (ammonia, carburetted hydrogen, etc.) and of *organic matter*.

The dark coloured impure or venous blood returning to the heart after passing through the lungs has now become

a bright red colour. It has been what is called ***arterialised*** or made fit to be in the arteries which distribute pure blood all over the body in order that it may carry on its work. When the blood cannot be purified the person dies. (He is said to be *asphyxiated*). When the blood ceases to flow, death occurs, as the body cannot carry on its work for more than a few seconds without receiving fresh pure blood. If the heart stops beating for a second the person faints and falls down unconscious and death-like. When the heart starts beating again the person becomes conscious of his surroundings and quickly becomes quite well again.

The excretory apparatus. The Lungs we have seen get rid of a large portion of the impurities of the blood. The remaining waste products are removed by *the sweat and urine.*

Lungs get rid of water and Carbonic acid gas.

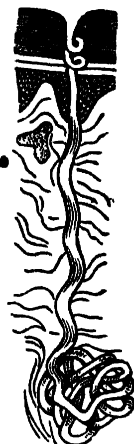
Sweat gets rid of water, carbonic acid gas and urea. *Urine* gets rid of water, salts, uric acid and most of the urea.

Urea is the form in which the body gets rid of most of its nitrogenous waste matter. Urea contains nearly half its weight of nitrogen. The healthy adult body loses nearly 500 grains of urea in 24 hours.

The urine is formed in the Kidneys each of which has a tube called the ureter which carries the urine to the Urinary Bladder, where it is stored up till an opportunity occurs to get rid of it. The presence of urine in the bladder is accompanied by the desire to pass water. The urine is then squeezed out of the Bladder by muscular action. The first chance that occurs should be taken of passing water when the desire to do so is felt, as it is bad for the body to retain urine. Headache and, in some people, a feeling of sickness are the results of retaining the urine too long in the bladder.

The glands of the skin mostly *secrete* or form *sweat* or perspiration which is a watery fluid with a salt taste.

Some of the skin-glands also secrete an *oily substance* (sebum) which gives the shining look to the skin and also helps to keep it soft and elastic. *By means of the sweat the heat of the body is regulated.* If you wet your hand with water and hold it in the air the hand becomes cool. This is because the heat of the hand changes the water on it into the condition of vapour. This is called evaporation. The heat thus lost to the hand gives the feeling of coolness.



Sweat gland

So with the swea'. The sweat glands pour out the watery sweat on the surface of the body when hot and th evaporation takes away heat from the body and thus cools it.

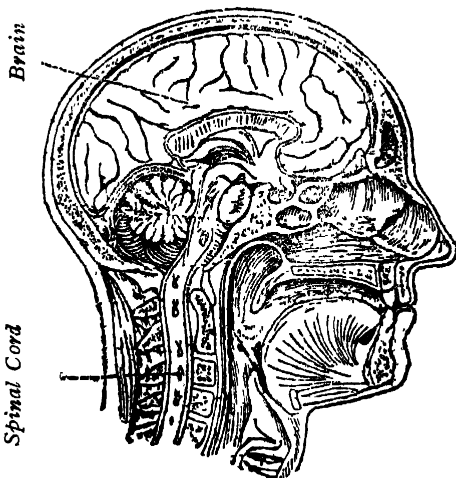
The amount of sweat varies greatly but generally more than three pints in 24 hours are given out. What makes the skin sweat? Heat. Yes, but how? When the skin is heated the nerves of the skin send messages to the brain and spinal cord which are the head-offices of the nervous system. Then the brain and spinal cord send message out along the nerves to the sweat-glands to pour out sweat. At the same time the blood vessels in the skin become fuller of blood and the person, if fair skinned, looks redder than usual. From this extra supply of blood the sweat glands draw out much water and also some of the waste matter of the blood. When a person has a 'cold sweat,' the sweat glands pour out sweat but there is not nearly so much blood in the skin as in the ordinary condition of perspiration.

In cold weather, the blood vessels of the skin shrivel up, so to speak, and drive the blood to the interior of the body. In this way loss of heat is prevented as not only is there very little perspiration but the blood is not cooled by exposure in the blood vessels of the skin to the cold air.

The nervous system is divided into

1. The Cerebro-spinal System which consists of the brain and Spinal Cord and the nerves which go from and to these; and

2. The Sympathetic System which is of less importance and consists of collections of nervous matter or cells from which pass nerves or nerve fibres. The Sympathetic System mainly controls the widening and narrowing of the blood vessels and the functions of the internal organs.



By means of the brain we think, wish, will, perceive, and command our muscles to work. It also, along with the Spinal Cord, carries on the working of the Heart, Breathing, Digestion, Secretion, Excretion. Besides, Hearing, Seeing, Smelling, Feeling, and Tasting are all due to its action. It is unnecessary to give any description of it here. Reference must be made to elementary books on Physiology for further information on this subject.

CHAPTER III.

WATER

Importance of its purity.

Pure Water and Pure Air are almost more necessary than anything else for the preservation of health. In India, when any one is describing a place the first questions asked are, Is the water good there? Is the air pure? And so all over the world. Men have suffered in all ages so much from bad water and foul air that even the most ignorant people understand how all-important is the purity of the water and air of the place in which they live.

If man cannot get water he dies in a few days. A man may live very much longer without any food but if he cannot get water he quickly dies.

Why is water so important to us? Because our bodies are mostly composed of it. Two out of every three parts of the body are made up of water. We have seen that we are continually losing water as it is given out in the act of keeping our bodies alive. From our skins water is constantly being given off, either as *invisible vapour* (insensible perspiration) or *as drops of sweat* (sensible perspiration). Besides, our lungs are giving off water at every breath we breathe out. This is shown by breathing on a cold mirror when the watery vapour in our breath will form a damp mist on the mirror.

Then again there is the loss by the urine and bowel-excretion (fæces).

This loss of water has to be replaced or our bodies will rapidly lose weight and if water is not provided we die. Ordinarily we get the necessary quantity of water from our drink and our food, for a large proportion of all foods consists of water. For instance, a seer of meat has about ¾

of a seer of water; and a seer of flour has about two chitaks of water. We must have pure water in sufficient quantity or we can never be well.

Now, *pure* water is *not* the same thing as *clear and tasteless water.* A water may be beautifully clear and have a sweet pleasant taste and yet it may be most impure and may cause the death of the person who drinks it.

Composition. It used to be thought that water was made up of only one substance, that is, that it was an element. The ancients used to describe water, fire, air and earth as elements. But Cavendish, an English Chemist, first proved to the world that water was not an element but was the result of the chemical union of hydrogen with oxygen. He mixed two volumes of hydrogen gas with one of oxygen gas in a strong glass vessel and then passed an electric spark through the mixed gases. An explosion followed and the inside of the vessel was found covered with droplets of *water*, as it was proved to be by comparing it with pure water.

Therefore, water is a combination of hydrogen with oxygen, in the proportion of two volumes of hydrogen with one of oxygen. Chemically pure water is never met with in nature as water has a greater power than any other substance of dissolving up some of the gases and solid substances with which it comes in contact.

What then is pure water from a sanitary point of view? It is a water practically free from injurious

(*a*) organic matters;

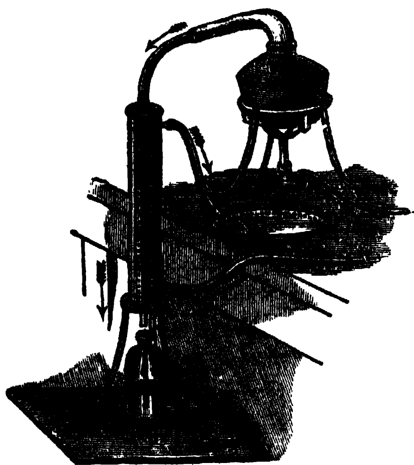
(*b*) gases;

(*c*) metals;

and (*d*) containing no excess of even mineral substances. But, above all, (*e*) it must be free from disease-germs.

The purest water obtainable is rain-water, when it is collected in clean vessels in the open country. *In towns*

the rain as it falls is made impure by particles floating in the air and by various gases present in the air. Rain water is the purest naturally-obtained water because it has been *distilled.* That means that it has been heated until it became a vapour, and that when the vapour was cooled it again became water. Now when the water becomes vapour it leaves behind practically all its solid impurities and this is why *distilled water is the purest and safest we can ordinarily get.* We can readily imitate this natural process of distillation by using an ordinary *still.* This consists of a copper degchi or pot covered in at the top so that the only escape for the steam (formed by boiling water in it) is through a pipe at the top. The steam passes through this pipe into a small *tin or glass* pipe constantly surrounded by cold water. The steam then becomes



condensed, that is it changes back to the ordinary liquid state, and runs down the pipe to be collected in a tin or glass vessel. Tin or glass should be used as the water cannot take up any poisonous substances from them. If copper or brass is used the water might become poisoned. But, you will say, why did you then use a *copper* degchi? Because even if the water takes up much copper from the vessel it does no harm. For the copper is *left behind in the degchi,*

as the water when it boils is changed into steam and the steam carries no copper along with it.

As with copper so with nearly every other poisonous substance in water. When the water becomes steam the poison is not also carried along with it but is left behind in the degchi. In nature, pure water is got by the aid of the sun's heat on the water on the earth's surface. The water is evaporated, forms a gas and rises up into the air until it gets to a height above the earth. Here the air is so cold that the water vapour is changed back to the condition of fluid and forms small drops of water. These drops of water form the clouds and when it rains the water is again returned to the earth's surface. It falls into the ocean ; it runs into rivers ; it falls into pools or lakes ; and it sinks into the ground.

Sources.

Natural waters may be :—

1. Rain water.
2. Surface water—on the surface of the grounds, *e.g.*, streams, lakes, ponds, and ditches.
3. Subsoil or ground water—not in free contact with the air but *under* the surface of the ground.
4. Deep spring or artesian well water. This lies very deeply under the ground and cut off from subsoil water by layers of earth through which the water cannot trickle.
5. Mineral waters, sea water, salt-lake waters.

The rain which runs into rivers, pools or lakes has first fallen on the earth where it may take up and carry along with it poisonous materials. In this way it may make rivers, ponds or lakes dangerous to drink.

The fæces of persons suffering from Cholera have been over and over again proved to carry that disease. Let us take an ordinary occurrence. A person living near a river is

attacked by cholera. He empties his bowels near the river. This dangerous poison trickles or is washed by rain into the river. People taking water from the river at or below this point may get cholera by drinking the water.

Again the water which sinks into the ground trickles through the earth until it finds its way into a well or until it cannot sink further through meeting what is called an *impermeable stratum* (that is, a layer of soil so dense that the water cannot get through its pores). In this case the water flows along the top of this layer and finds its way at last to some underground lake which may be the starting point of some spring of water, or well. Now supposing that a man ill with cholera empties his bowels on the surface of the ground near a shallow well. The watery part of the fæces sinks through the ground and finds its way into the well, carrying the cholera poison with it. Water from that well is now poisoned and will cause cholera among those who drink of its water.

The following is a good classification for waters from different sources according to their wholesomeness, taste and usefulness for drinking and cooking purposes :—

Wholesome to use	1. Spring water	very good taste.
	2. Deep well water	
	3. Upland surface water	good taste.
Suspicious to use	4. Stored rain water	
	5. Surface water from fields	fairly good taste.
Dangerous to use	6. River water into which sewage passes.	
	7. Shallow-well water	

Artesian wells are wells made by boring very deeply into the ground and the water from these wells generally spouts high into the air as it is under great pressure from being so far below the surface. They generally yield very pure water.

Relative value of river, tank, well, and rain waters.

River Water. If river water is taken from a river near its origin or source and before it reaches inhabited and cultivated lands it is generally safe. But where there is a village on the banks it is always unsafe because many people in the village make a practice of throwing their house refuse or waste matter, as well as their fæces and urine, into the river. So if there is any disease which can be carried by these means—and in every large village or town this is likely to be so—disease will follow from drinking this defiled water. So also with cultivated fields. People frequently go there to empty their bowels. Water flowing from these fields into a river carries the poisonous particles into the river. These particles in the water are then drunk by some one who gets ill in consequence. Ships and boats also help to defile rivers. The people on board these throw their motions and urine and other filth into the river. Again animals defile water near the villages. The animals are taken to the river to drink and their "droppings" or fæces poison the water.

Water from rivers into which factories discharge their waste liquids is also injurious to health.

When the river is in flood its waters are particularly dangerous for then there is more poisonous matter in it—due to the greater amount of fæcal and other matters washed into it by heavy rain. River water ought not to be drunk unless first purified by the means to be stated later.

Purification by Subsidence: As a river flows along, the solid particles carried with it tend to drop to the bottom and thus a river tends to purify itself. If a river has been contaminated at a certain point it may be found quite free from that particular contamination, say, 5 miles lower down. If also the river falls over waterfalls (or weirs) the water is purified by being mixed with the air.

But neither of these means must be too much trusted to. For in a flood they practically cease to have much purifying effect. The sun is a great purifier of water as most germs of disease cannot live if the rays of the sun fall on them for long.

Tank Water. A tank is a natural or artificially made hollow in which water is collected. The water comes either from springs in the foot of the tank or from streams flowing into the tank (hence such water is often termed "surface-water"). The ways in which a tank's water may purify itself are by settling of the solid particles to the foot of the tank; by fish and other living creatures which eat up some of the impurities; and slightly by exposure to the sun and air.

But these means are so very uncertain that no reliance must be placed on them. Tanks cannot purify themselves even to the extent rivers can because, of course, there is no flow in them, nor can they be subjected to the action of waterfalls. Water from shallow depressions in the ground, *khals*, &c., runs special risks of being badly contaminated. It should therefore, be avoided particularly for drinking and cooking purposes.

Tank water in India is often very foul and is a great source of disease.

Many people in India imagine that if they strain the water they are about to drink through a piece of muslin or cloth that will purify it. Everyone in India must often have seen people straining drinking water through filthy clothes. How can putting filthy water through filthy muslin purify the water?* The muslin is made up of cotton fibres

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* *Manu* directed that water should be drunk only after filtering through cloth. This recognises the necessity for purifying water though the method advised is useless. But the *Susruta* gives many good rules for the purification of water such as boiling and filtration.

between which are holes or pores through which the water runs when being strained. The pores are always too big to strain off anything really harmful. Take the case of cholera, for instance. This is a living thing so small in size that it cannot be seen by the eye at all. It requires to be placed under a very powerful lens or magnifying glass (microscope) which makes it look enormously bigger than it really is. If it is so small then how can the muslin threads hold it back? As a matter of fact, if you were to place a hundred of these invisible animals side by side they would easily find their way through any of the pores of the muslin. The muslin can only stop coarse grains of sand which after all would not cause much harm if swallowed. The muslin, therefore, can stop nothing that is very dangerous.

What is commoner than to see people bathing in a tank and washing in it and then drinking the water? Worse than that, what is more usual than to see people spitting and washing their teeth and even passing urine into a tank?*

Suppose that a man who has just recovered from cholera bathes in a tank—what is the result? He poisons the water by spitting into it; and he washes his body which may be soiled with dried portions of fæces which are full of the cholera poison. Other people swallow these particles and get cholera.

Again people in most cases use the banks of tanks as a convenient place for emptying their bowels. The next shower of rain washes the motions into the tank. Again cattle are watered and washed; filthy cooking pots, grain,

*"Urine and stools should not be passed into river water or on its banks, in burial-grounds, near inhabited localities, within grazing grounds, fields with corn or cultivated fields." *Vishnu* (*Purana*).

"Let him not void urine on a road, on ashes, or in a cowpen, nor on ploughed land, in water....nor on reaching the bank of a river. Let him not throw urine or fæces into the water, nor saliva, nor clothes defiled by impure substances." (*Laws of Manu*).

fruit and—worse than all—filthy clothes are washed in the tanks. The pots, cattle, grain and fruit make the water foul and such dirty water causes diarrhœa and other worse troubles. But the dirty clothes are most dangerous of all. Suppose a man has been suffering from dysentery or cholera and his clothes are fouled with fæces. The linen is then washed in the water which is thus poisoned with the particles of fæces washed off the clothes.

In Eastern Bengal and elsewhere there is a very bad custom by which Muhammadans bury their dead on the banks of tanks and rivers. Similarly, Hindus pollute rivers by throwing *partially burned* corpses or the carcases of animals into rivers. (Where the body is *burnt to ashes*, no harm can be done by throwing the ashes into water).

All wells yielding bad water ought to be closed. All tanks yielding dangerous water should, if possible, be filled up. If a pure supply of water is brought into a town by Government or a municipality that is not enough. For lazy and ignorant people will take their water from a foul well or tank close to their houses rather than walk a few yards further on for pure pipe-water. So all bad wells and tanks must be got rid of so that people may not continue to use them and thus cause disease to themselves or their neighbours.

Have separate tanks for bathing ; and others for washing cattle. Never take drinking or cooking water from these. Take care that no drains open into the tank.

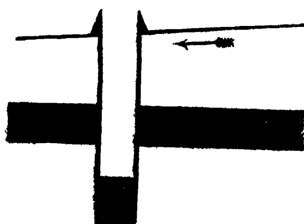
Wells may be either shallow or deep.

A *shallow well* is one made in layers of the soil lying *above* an *impenetrable** layer of the soil. It gets its water supply from the soil round about it. As this water may only

**Impenetrable* that is to say that the water trickling down from the surface of the ground cannot get through that layer.

have passed through a few inches or feet of soil before reaching the well the water has not passed through a sufficient amount of soil to remove any of its impurities. Shallow well water is, therefore, always a suspicious source of water-supply. A " Kutcha " well is merely a hole dug in the soil in which water collects and such wells are always liable to be much contaminated. If such a well is lined with bricks or masonry it is called " pukka."

Deep wells, on the other hand, yield generally pure supplies. Why ? A deep well is one whose water comes from a layer of soil lying *below* an impenetrable layer of soil. If the well itself is properly made then you will see from the *diagram* that the water in the upper layers of the soil cannot get into it. That means that all the water from a good " deep " well is free from mixture with imperfectly strained water.



The deep well water has generally travelled some distance *horizontally* through the soil as the diagram shows.

There is in fact in most places a stream of underground water flowing in the direction of the slope of the country at that particular place. The water flowing through the soil gets its harmful portions strained off—*filtered*—and at the same time it is protected from the water sinking from the surface of the soil by means of the impenetrable layer which stops the surface water from sinking deeper.

Deep well waters generally yield good water but it may be rather " hard." *A hard water* is one containing a large quantity of lime and magnesium salts. The consequence is that such waters do not readily make a " lather " or froth with soap and so more soap is used or wasted by these

waters. Stone in the bladder is also often caused by drinking hard waters.

Hardness is called "Temporary or Removable" if it nearly all disappears after the water is boiled. The reason of this is that boiling drives off the carbon dioxide gas which helps to keep the carbonate of lime, etc., in solution and the result is that the carbonate of lime falls to the foot of the vessel leaving the water much less hard than before. *Permanent hardness* cannot be removed by boiling and is due to the presence in solution of salts of lime and magnesium which are *not* kept in solution by the aid of carbon dioxide as in the case of the temporarily hard waters. Rain water and upland surface waters are "softer" than most other waters. Well waters are generally "harder" than other waters.

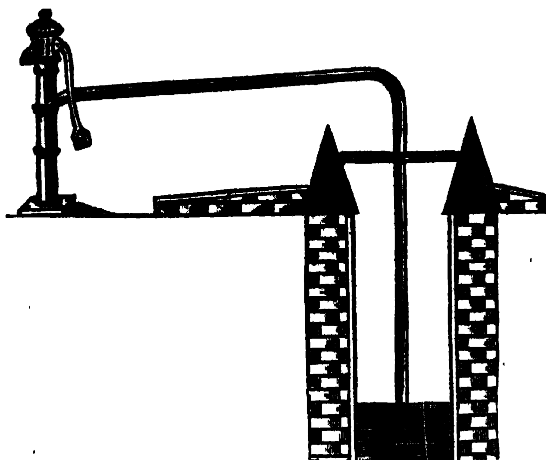
Even a deep well originally yielding very pure water may quickly become a source of disease and death unless care is taken of the well's sides and above all of the mouth of the well. If any filth trickles back into the well the water in it will be spoilt and made unfit to drink. At the end of the book, Appendix 2, will be found lists of questions to be filled up by Government officials in Bengal when sending Well, River or Tank water for chemical analysis. These lists will help to show what points are of special importance as regards these sources of water-supply.

A good well

1. *Should be lined with an impenetrable lining from its mouth down to the level of the impenetrable layer of the soil which it pierces.* Generally this is done by lining the inside of the well with brick work covered thickly by cement on the free inner-surface. (This is called *steining*). Take care to see that any cracks forming in this are filled up at once with good cement.

2. The well's mouth must always be kept closed tightly

so that filth may not drop into it. There should be a trap door with hinges to close as soon as water has been drawn from the well.



3. A bucket may be used or, best of all, a pump to draw up the water. If a bucket is used it should never be made of leather as is so often done (as it cannot be kept clean) but of *metal*—zinc being perhaps best of all. Chains are better than ropes which easily get dirty. ***Private lotahs or ghurrahs should never be lowered into a well.*** If the well mouth has to be uncovered while drawing water the cover should be at once put on again after drawing the water.

A pulley should be used for the chain and bucket which should not be lowered by hand direct.

The best plan is to have a pipe going down into the well. This pipe goes to a pump placed ***a few feet away from the well-mouth.*** The well is then always kept closed—the cover being fixed tightly on and kept locked—and the pipe passes through this cover. In this way no one need go to

the mouth of the well and all the water can be taken from the pump without any risk of filth getting into the well when the cover is removed. Covering the well prevents birds getting into it and building nests in the well and dropping their fæces into the water. It also keeps out leaves, dust, straw, mud, etc., which may poison the water. It also prevents dead animals being flung into the well. The cover must fit so tightly that dust and water cannot get into the well.

4. There should be a masonry parapet wall rising 2 *or* 3 *feet at least* above the mouth of the well. This wall should have a sharply pointed top to prevent people using the mouth of the well as a seat.

5. The space round about the well should be kept very clean and should be preferably paved or (if possible) cemented. The platform should slope outwards from the well. This is to prevent water split near the well from finding its way back into the well which, however, it should not be able to do if the well is lined with cemented brick-work. There should be a *pucca* drain to lead off water from this platform.

6. No latrine or refuse-pit or cess-pool should be placed anywhere near the well.

7. No washing of clothes or of cooking or other vessels should be carried on anywhere near a well used for drinking purposes.

8. Any hollows near a well in which water can collect should be filled up.

Go to any ordinary village well, and you will see people drawing water from it and using filthy ropes, and filthy *chattis* or *lotas*. The people stand round the well, water is split while being drawn, and it falls on their bodies to trickle back into the well. Dirty clothes (perhaps from a cholera patient) are washed at the well mouth and the washings

trickle back into the well. Men bathe at the mouth of the well and the water from their bodies trickles back into the well.

Baths of recovery, taken by people just recovered from illness, are also often taken at well-mouths.* *Cattle* ought never to be watered near a well as the cattle's "droppings" (fæces) are apt to be carried into the well-water.

Cleaning of wells.—Pump the well dry and clean it out *at least* once a year. Do this, if possible, *during the hot weather*, when there is least water in the well. Scrape its sides and remove all rubbish, etc., from the foot. Then apply a thick layer of paste made of water and *quicklime* to the sides and foot.

Disinfecting the well by throwing in a mineral salt called *Potassium Permanganate* is much used. This substance cannot be objected to by Hindus on account of "impurity" as only mineral matters are used in making it. For an ordinary-sized well, 1 to 4 ozs. of these crystals are generally enough. A light red colour that lasts for 8 hours should be produced by the Permanganate.† If the well water is bad a larger quantity of the Permanganate will be needed. When the red colour changes to brown it shows that the Permanganate is being used up by the dirt in the well. Therefore, the Permanganate should be added until all the dirt has been rendered harmless. This is why the direction above was given as to the red colour lasting for 8 hours. It is best to add the Permanganate at night so that the well water may be left undisturbed. The Permanganate should be placed in a bucket which is then lowered into the well. Then draw it up and pour into the well what has been

*"He must not throw any impure substance into water."
(*Institutes of Vishnu*).

†If this is done in the evening the water will be fit to drink next morning.

dissolved. Repeat the process till all the Permanganate in the bucket has disappeared. The water even if red is quite harmless, as the Permanganate is not poisonous when so greatly diluted. It may have a slightly unpleasant taste but this does not mean that it is unsafe to drink. This method gives good results when cholera is prevalent.

Transport of drinking water.—The mashak ("mussuck") should never be used for carrying drinking water. It cannot be kept clean and if the water-carrier (bhishti) happens to live in a house where there are cholera, dysentery or enteric sick persons there is every risk of the mashak becoming poisoned by the germs of these diseases.

Two well-cleaned kerosene tins may be used, but close-fitting lids with hinges should be fixed on each tin. These tins can then be slung on a pole for carriage. The kerosene tins should, of course, be changed when rusted or leaky.

Large brass vessels (kept very clean) are also good for the purpose but are generally more difficult to fit with lids and cost more.

In few Indian towns is any method but hand carriage of water possible at present. But, where there is a proper filtered supply run through pipes laid below ground and properly supervised, this is best. The water is supplied from street or other stand-pipes and very rarely brought by pipes into the houses, as in Europe. Hence the special necessity for care in carrying water from stand-pipe to house in suitable vessels, as above indicated.

It is generally speaking, a bad method to supply two kinds of water—pure for drinking and a less pure for other purposes. For, in this case, the less pure is used for drinking by careless or ignorant people and often with grave injury to health. Again, the same set of vessels or pipes must never be used for carrying drinking water as well as,

at other times, less pure water used for other purposes. This practice has frequently caused various diseases to occur.

Water should be stored in *glazed chatties or ghurrahs* and these should always be kept perfectly clean and cool. Why should the *chatties* be glazed? The reason is that unglazed chatties take up filth by their pores but in the glazed kind these pores are filled up by the glaze and so glazed chatties cannot take up dirt. The glazed smooth surface is also much more easily kept clean than the unglazed.

When copper sulphate or chloride *in very small amounts* (one part in ten thousand) is mixed with water it appears to have a purifying effect; but the water must be left for an hour or two before this purifying action is complete. It is safer not to use copper sulphate or chloride which is poisonous but to place the water in clean copper vessels for at least an hour. The vessels must be quite clean or poisonous green or blue copper salts will form on it.

Glass or slate cisterns are best of all but they are usually impossible for Indian houses on account of their expensiveness. Clean copper vessels or glass-bottles with tight-fitting glass stoppers are best for use in houses for storing small quantities of drinking water. It is usually impossible to pour *boiling* water into glass bottles without cracking the bottle. But earthenware or China vessels or even enamelled ware can safely have water poured into them at boiling point and this plan also has the advantage of thoroughly purifying the vessel from any germs.

The vessel (closely-stoppered or even covered with clean muslin) can then be cooled by placing in an ice-box or by swinging it in the verandah in a basket packed with damp grass.

All vessels used for storing water must be kept covered so as to prevent dirt and dust from falling into the water.

All vessels for storing water must be regularly emptied and cleaned out with soda (washing soda) or, if of metal, washed with Brook's soap (Monkey Brand) so that all surfaces are quite clean and free from slime.

In Bengal (and probably elsewhere) it is a common practice for the women and children of the house to bathe in the tank from which the drinking water is taken. This is a foul and most dangerous habit and should never be allowed.

Again people wash their bodies and spit and wash the mouth and other parts in the water of a tank or stream used for drinking purposes. They may then collect the water quite close to this for the cooking and drinking supply for that day. The dangers of this have already been pointed out.

If you want to be quite sure that you will keep free from diseases caused by impure water you must take care never to drink any water that has not first been boiled.

Why is this ? Because boiling kills the germs or invisible living substances which cause disease.

To make certain, then, do as follows :—

I. See that the water provided for drinking purposes in your house has been boiled.

Now by boiling is not meant merely heating. But what is meant is that the water should be kept heated *above the point at which the crackling sound* (*made while water is being heated*) *has stopped.* In boiling water, when you begin to heat it, no sound comes from it at first. Then it begins to " sing " or crackle. Then after a time this loud crackling sound stops. That is the boiling point. *Now the water must be kept at this stage for five minutes at least.* Then it will be safe, for the germs which cause cholera, typhoid fever or dysentery will have been killed and thus rendered harmless.

II. After the water has been kept boiling for five minutes, cover it and let it cool.*

Keep the water in a cool dark portion of the house or in an ice-box in a clean, covered vessel.†

Filters need not be used if the water is boiled as it is now known that filters *of the ordinary type* do more harm than good. The only filters that are of any use for making water free from germs are the following. *The Pasteur Chamberland filter* which is made of very finely porous porcelain is the best of all filters. (The Porcelain d' amiante filter is another very good form of it). *If free from cracks or defects and if kept perfectly clean,* it will strain off even microscopic germs from the water. It allows *chemical* substances in solution to pass through its pores but these do no harm. Another filter of the same kind is the Berkefeld filter. It is made of infusorial earth (compressed). It is not nearly so reliable as the Pasteur Chamberland filter and is more easily broken. The Berkefeld filter, however, allows the water to pass much more quickly through it, but needs cleaning much oftener. All these filters only act well under some pressure of water. *When using either of these filters in India, it is best to pass the water through an ordinary type of filter first so as to remove slime and mud.* Then filter this water through the Pasteur filter.

Since Pasteur Chamberland filters have been used in the barracks of the French army, it is claimed that epidemics of cholera, typhoid fever, etc., do not occur. Pocket filters of

*You will have boiled the air out of it and in order to make the water pleasanter to drink it is often poured backwards and forwards from one perfectly clean vessel to another several times so as to mix it with the air. If this is not done the water will taste "flat" and unpleasant. Another good way is to shake up the water in a *half-filled,* clean, stoppered bottle.

†Alum is often added to water to make it clearer: 6 grains of alum to every gallon of water. This alone is not able to make bad w ter fit for drinking. It must be boiled as well.

these types can be obtained which work by sucking the water through them. When a Pasteur Chamberland or Berkefeld filter is yielding less water than usual it needs cleaning. It is best, however, to clean it at regular fixed times, and not to wait for it to get blocked up.

Water passes very slowly through these filters.

It was mentioned that Pasteur or Berkefeld filters can only be used "under pressure," that is where there is enough force or weight of water to force the water through the filter's pores. For instance, it could be easily used in any town where there are supply-pipes for water as the force with which the water issues from these forces the water through the pores of the filter. Again, if a tank of water was placed on the top of a house and water pumped up into it, then if in the lowest rooms of the house a Pasteur filter was screwed on the water pipe coming from the tank on the roof the weight of the column of water would force the water through the filter.



It is often claimed for the Pasteur filter that it does not require to be cleaned frequently—not for months perhaps. This is a false and dangerous statement. A Pasteur filter required to be cleaned very often when impure water is being used. In India it should be cleaned as advised at least once a week as most of the supplies of water in India are less safe than in England.

When a Pasteur filter is used and frequently cleaned,

boiling the water is not necessary for the germs are kept back by the pores of the filter and are thus got rid of just as well as if they had been killed by boiling. To be quite sure of being safe, a Pasteur filter must be cleaned about once a week (oftener if the water is very foul or dangerous). Otherwise the germs will have time to *grow through* the pores. This can be prevented by:

Cleaning the filter thus :—

1. Detach the Pasteur candle (the white porcelain portion) and place gently in a degchi and cover well with water. Then with a soft brush, or piece of muslin, gently wash the outside of the candle.

2. Then pour out the dirty water and again place the candle in the degchi, and pour in water till every part of the candle is covered an inch deep with water.

3. Then add some sodium carbonate* *and boil.* Keep the water *at the boiling point* for 20 minutes at least.

4. Cool and remove the candle and fix on again to the tap or other source of water. The filter then can be used again.

The ordinary Indian domestic filter :—

A variety of filter which is much used throughout India is made by placing three chatties one over the other. The top chatti holds water which finds its way through a hole in the bottom of the chatti into the middle chatti, in which is a mixture of sand and charcoal. The water trickles through this and out through a hole in the foot of the middle chatti into the lowest chatti of all which holds the filtered water.

Filters like this are *useless and worse than useless.* They are useless because the sand and charcoal will not keep back any germs of disease which may be in the water.

Not only are they useless but they are also often very

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*This should be got pure from a chemist's shop. *Sajjimati* is usually too impure for the purpose.

dangerous for the sand is frequently taken from a river-bank, which is a favourite place for men and animals to empty their bowels. So that the sand may be full of disease-germs. It may thus happen that a water, which is pure when put into such a filter, gets poisoned with disease-germs. So the water is much more dangerous after coming through such a filter than before it was put in. Numerous cases occur in which people get cholera, enteric fever etc., from using unclean or useless filters.

Most Hindus consider that they have done enough to purify the water they drink when they have strained it through a cloth of some kind. It will be seen from what has been said that such a belief is founded on ignorance and that the only way in which water can be made safe to drink is :—

(*a*) by boiling it (best of all) ; or

(*b*) by filtering it through a carefully cleaned Pasteur filter which will strain off any germs of disease ; or

(*c*) by using a water of undoubted purity—that is one whose purity has been proved by repeated chemical and bacteriological examination.

But even a combined chemical and bacteriological examination may prove quite misleading unless very recently made. For a water proved to be pure by such examination when made may become badly contaminated shortly after the water was drawn for examination. So that this fact must never be lost sight of when considering the results of any such examinations. *In India, it is safer to assume that all drinking water is of suspicious quality and boil it.*

Characters and classification of potable waters.—Waters are described according to the results they give after chemical analysis.

Perhaps as useful a classification as any is the following of Dr. Parkes's :—

1. "Pure and Wholesome Water."

2. "Usable."
3. "Suspicious."
4. "Impure."

Nos. 1 and 2 are fit for drinking; and Nos. 3 and 4 are unfit for drinking. (It would be of little use in a work of this nature to describe the analytical details on which the above opinions as to the quality of the water are based). The opinion of the analyst will be given in every report on the analysis of a sample of water.

Water is often brought into towns from long distances by pipes. For instance, Calcutta is supplied from river water taken from the river Hughli some miles above the town. Madras and Bombay are supplied from hills some distance away by pipes. One great advantage of this latter plan is that the water is taken from a place with no dwellings near it. Its purity can be easily guarded and contamination from any source prevented.

Some places depend for their supply on *rain water* stored in underground reservoirs, which have to be made of impervious cement. The pipes which distribute the water to different houses are often made of lead. Galvanised iron pipes are better. Some waters dissolve lead rather easily and so lead poisoning might occur. Constant colicky pains and other symptoms occur in such cases. The pipes must not leak or the water will be poisoned by the gases and other impurities of the soil.

Diseases caused by an impure water supply.— Bad water is the source of many of the most fatal diseases which attack man, for example, Cholera, Dysentery, Diarrhœa, Enteric Fever, Stone in the bladder, goitre, skin diseases, worms etc.

Most of these diseases may come from drinking water which has been contaminated by the excretions from people's bowels. It is surely worth while to make every effort in

order to save ourselves from such disgusting and dangerous results. A few examples of how diseases have been proved to be spread through the water supply may here be given.

Broad Street Pump Case. It was clearly proved in this classical case that only the people who took water from one pump (in Broad Street, Westminster, London) suffered from Cholera while those people who did not use this pump-water escaped Cholera. In other cases the people living in houses on one side of a street suffered severely from Cholera while those living on the opposite side of the street have escaped. In such cases it has been proved that the people attacked with Cholera were supplied with water contaminated by the fæces of some Cholera patient, and that the people who escaped were supplied from a different source with pure water.

Glasgow used to be supplied with impure water from the River Clyde and then the inhabitants suffered very severely from Cholera epidemics. For instances, in a cholera epidemic in 1832 there were 2,800 deaths; while in 1854 there were nearly 3,900 deaths. But later a pure supply was taken from a lake situated many miles away from the city and every care was taken to prevent the lake water becoming foul in any way. The result was that, in the year 1866, when Cholera was raging in Scotland, there were only 68 deaths from Cholera in Glasgow. Compare this with the result when this city was supplied with impure river water.

The same is true for India. But examples need not be multiplied by quoting Indian instances. When a pure water supply exists Cholera may be brought to a place but it will not spread, if care is taken to guard the water-supply from the stools of people ill with cholera. Again in very many cases, Enteric or Typhoid fever has been traced to the use of polluted drinking water. Here is one example which occurred at Caterham in England. A workman suffering

from mild Enteric Fever was in the employment of the Company which supplied many of the people of this small town with well water. The stools of this man were proved to have contaminated the water and the disease *was found to have occurred only in those people who had drunk this water.* The wells were pumped dry and cleaned out and no more cases occurred. The people who had escaped the disease had used other water than that infected by this workman.

Another example is that of a prison in which enteric fever was always occurring. The water supply was drawn from a river into which the fæces of the inhabitants of the neighbouring town were thrown and which caused the disease. The water supply was changed and obtained from carefully protected wells and enteric fever ceased in that jail from then onward.

Diarrhœa may be caused very readily by foul water. This is due to germs from the bowels of men or animals. These germs feed on animal or vegetable particles in the water and when swallowed by people they set up irritation in the bowels and consequently diarrhœa. It often happens that a water causes diarrhœa because of the large amount of vegetable or other irritating matter in it. Such water ceases to have this effect when simply filtered, for the filtration removes the irritating particles from the water.

Water which has become foul from contamination from a burial ground is particularly harmful.

Mineral salts, such as nitre and nitrate of lime, etc., when present in fairly large quantity in water are also very liable to cause diarrhœa.

Water which is "brackish" (or has more or less salt from mixture with sea-water or from having trickled through loose sand or soil containing much salt) is also very apt to cause diarrhœa.

But diarrhœa of the most severe form is usually caused by drinking water into which sewage has found its way.

Dysentery is very frequently caused by drinking water fouled with sewage or which has passed through a cemetery or other impure ground. This has over and over again been proved.

Further, the fæces from a person suffering from dysentery will spread the disease to other people very rapidly. It is, therefore, necessary, as we shall see later, thoroughly to destroy the disease-germs in the stools passed by patients suffering from dysentery, cholera, enteric fever, etc.

Lastly, when diarrhœa or dysentery is very common in a village or town, especially when it occurs only at one time of the year, the cause is, in all probability, bad water.

Malarial fevers. Water taken from marshes has always been believed to cause fevers. It is, difficult, however, to believe that this is so. For the people who drink marsh water are also exposed to the other conditions which give rise to malaria, such as mosquitoes.

Oriental sores and other skin diseases, as well as guinea-worms, may be caused by washing with infected water.

Goitre. In this disease a gland in the front of the neck becomes much swollen. Water which has been contaminated by passing through filthy soil usually is the chief means by which goitre is spread. All the evidence points to the cause being a germ but so far no germ specially has been identified as the goitre-causing germ. The chemical constituents of water do not appear to be able to cause goitre, as was formerly believed.

Some years ago, the writer was in medical charge of a hill school for soldiers' children in India. When the children came to the school they were usually quite free from goitre. But, if they drank the water drawn from springs, on the hill-side there, they got goitre. If they only drank water

from the same springs ***which had been boiled***, they did not get goitre. It has lately been shown that even rain-water collected in such goitrous places may cause goitre. Here the dust poisons the water. Hence the lesson is clear: When the goitre is prevalent in a place, only drink boiled water—recently boiled and kept in clean tightly-covered vessels.

Worms. The following are introduced by water. Tape-worms, round-worms, thread-worms—all of which cause great wasting, &c. Another kind of worm lives in the Duodenum (Ankylostoma duodenale) and causes bloodlessness, wasting, and even death; and another worm inhabits the blood and also blocks the lymphatic vessels and is known as Filaria Sanguinis Hominis and it causes elephantiasis and milky urine. Again there is a parasite (called Bilharzia hæmatobium) that gets into the kidneys and causes blood in the urine. These may be introduced into the body by the water in the form of eggs which are invisible on account of their small size. We can see these eggs by means of the microscope. *Leeches* very often get into water and cause great loss of blood when they lodge in the throat or nose.

Artificial water-supply and the different ways of effecting it.—Water-works, etc. An artificial water supply, strictly speaking, would be one which was not obtainable by such natural means as springs, tanks, rivers &c. Wells might even be called an artificial water supply as the water has to be sought by artificial means—by digging. But what is perhaps more generally understood by an artificial supply is one obtained by storing and filtering water from any natural source—river, surface water. Or again, in some places, Artesian wells are sunk long distances into the soil and underground collections of water are in this way tapped.

The collection and storage of water is an engineering problem and unsuitable for discussion here. The filtration

of supplies of water for a town is generally carried out as follows :—



(*a*) The water is collected in a suitable reservoir or tank and there allowed to settle for some time. In this way any solid matters held in suspension by the water separate out and fall to the foot of the Reservoir from which they are, from time to time, removed by scraping. The water after having been a sufficient time in this *settling tank* is then run off into

(*b*) *a filtering tank.* This is a walled-in tank the bottom of which consists of layers of gravel or fine stones and also of layers of sand of different degrees of coarseness. The water trickels—the slower the better—through the gravel and sand layers which keep back much of the impurities present especially by means of the layer of *slime* that forms on the surface.*

(*c*) Then the water is collected in a covered reservoir for distribution to the different houses in the town.

*This slime layer gets so dense that from time to time it has to be scraped off. A fresh layer of slime forms in about 1 or 2 days. While one set of filter beds are being cleaned the water is filtered through another set, so that the whole number of filter beds is never in or out of use at the same time.

In the plains of India which are very flat generally a pipe-supply of water has to be pumped up to tanks some height above the ground and then from these tanks it flows down through the pipes to the houses. Unless the tanks are higher than the houses the water will not flow into house-pipes. Water always tends to seek its own level as is shown by the case of fountains. The water in a fountain spouts up into the air because it is trying to reach the level of the reservoir from which it came. Suppose a tank of water to be placed several feet above the ground and that from it a pipe passes to the ground. Allow the water to escape from the end of the pipe and it will spout up to try to reach the level of the water in the tank.

So in order to supply any particular place with water from a distance it is absolutely necessary that you should have the place to be supplied at a *lower* level than the place from which the water comes.

It is very desirable that the height of the reservoirs should be sufficient to carry the water several feet above the tops of the highest houses in the town in case of fire.

In a town supplied with water by pipes the supply may be turned on all day and all night. This is a constant supply. Or, as in Calcutta the water may be only supplied at certain hours every day. This is called an *intermittent* supply. A constant supply is to be preferred but in India it is often impossible to do so for many reasons which we need not here consider.

Amount of water needed. This depends on the habits of the people who are going to use it. For drinking, cooking, bathing, washing clothes and cooking-vessels and other house-hold purposes about 30 gallons *a day* for each grown-up person is allowed in Europe. About 15 gallons is allowed for each child.

In India it is usually found that much less is used. A supply of from 16 to 20 gallons daily for each grown-up

native of India is by many considered quite enough ordinarily. Europeans bathe more frequently and therefore need about twice as much as this.

In Calcutta as much as 41½ gallons of filtered water daily for each person have been distributed. This, however, does not mean the amount actually used by the people, as the *waste* of water in Calcutta is enormous. Unfiltered water for watering gardens, flushing drains, etc., has amounted to nearly 121 gallons for each person daily.

Allowance must also be made for cleansing latirnes. Also for the needs of cattle. A horse needs 12 to 16 gallons a day. A cow needs 10 to 12 gallons a day. This varies according to season, size of animals, etc. Water for trade purposes, for public baths and latrines, for cleansing drains and sewers (where used), for watering streets, etc., has also to be allowed for in calculating the quantity required for any place. A large margin must be allowed for waste. People, of course, ought never to leave water running from a tap. Shut off the tap after using it, otherwise great and useless waste occurs.

CHAPTER IV.

AIR

Composition. Atmospheric Air is a mixture of gases with solid particles floating in it. Pure air has no smell whatever.

Air is a mixture mainly of the following gases—Oxygen, Nitrogen and Carbonic acid gas. In one hundred parts of air there are generally 20·96 parts of oxygen, 79 of nitrogen and 0.04 of carbonic acid gas. Also minute traces of ammonia, of ozone (a concentrated form of oxygen) and a varying amount of watery vapour.

In rooms where the air cannot readily mix with the outside air the amount of oxygen becomes less and the quantity of carbonic acid gas greater. Air leaving the lungs contains *about* 4 per cent. more carbonic acid and 5 per cent. less oxygen than fresh air entering the lungs. Breathed-out air also contains much more watery vapour.

Carbonic acid is a very poisonous gas and when breathed in large amount causes death. Till quite recently it was wrongly believed that even small quantities of this gas cause headache and a feeling of suffocation and the other unpleasant symptoms which come on when a number of people have been crowded together in a badly ventilated room.

When air is heated it swells and takes up more space. Heated air is much lighter than cold air and in a room the heated air rises to the top of the room while the colder air tends to lie at the lower parts of the room.

All gases tend to spread equally throughout the space in which they are present (Law of Diffusion of gases). We thus find that Carbonic acid which is a far heavier gas than Oxygen or Nitrogen is present in the same proportion on a

hill-top as on the plains. In a room full of hot air the Carbonic acid gas does not fall to the floor because it is heavier than the other gases present but is (through being *heated* and by diffusion) spread equally all over the room. Oxygen is the gas which is drawn into our lungs and from there enters the blood and goes to all parts of the body burning up and destroying impure matters. This burning up is not the only cause of the heat of our bodies, for this is also caused by the heat produced by the chemical changes which accompany the action of our muscles, digestion, etc.

Nitrogen is a gas which dilutes or makes weaker the Oxygen of the air.

When an animal is placed in a closed chamber *without* Oxygen it dies in a "fit" or convulsions. If Oxygen is gradually introduced before the convulsions become too marked the animal generally recovers. But when *too much* Oxygen is given then the animal dies in convulsions.

Air also holds a quantity of watery vapour. The warmer the air is the more watery vapour it can hold. But when the air is cold, as in the early morning or at night, the watery vapour in it is *condensed,* that is, the small invisible drops run together and form drops large enough to be seen and this is called *dew, mist* or *fog.* These small drops of water are entangled with the air particles and are too light to fall to the surface of the ground.

Rain occurs when the water drops are so large and heavy that the Earth's attractive Force (called Gravitation) draws them down and the drops then fall as rain.

It is the large amount of watery vapour and of heat in the air of crowded rooms that makes it so unpleasant and makes us feel as if we can hardly breathe. The air also contains traces of ammonia and, when pure, of ozone which is a modified and specially active form of oxygen; and some organic matter. This last is rarely absent from ordinary

pure air but is then in harmless amount. But in the air of crowded rooms the organic matter is much increased. Generally the amount of organic matter is in proportion to the quantity of carbonic acid gas present.

Rain is a great purifier of the air. It washes down impurities floating in the air and thus makes the air fresher and more wholesome.

Impurities of air.—Every grown-up person gives out from his body a little more than 6 cubic inches of Carbonic acid gas every hour. That is to say that if we had a box 6 inches long, 6 inches broad and 6 inches in height a grown-up person could completely fill it in an hour with pure carbonic acid gas. Now if a man is sitting at rest in an empty room which is 10 feet long, 10 feet broad and 10 feet high (or, in other words, contains 1000 cubic feet of air) the air will require to be renewed in 20 minutes. So that if this room is to be kept healthy we must change the air *thrice every hour.*

If the room had only 500 cubic feet of space we must consequently change the air 6 times every hour to keep it healthy.

But if the man be working *hard* he will produce about 1·6 cubic feet of carbonic acid gas in an hour. The air will then require to be oftener renewed than when no work is being carried on in the room. In a room where a man is asleep much less carbonic acid gas is formed than in a room where a man is doing hard muscular work. Also the amount of carbonic acid gas given off by a person depends on age and sex, as children and women give out less than grown-up people. Again if a fire or lamps are burning in the room they will give out much carbonic acid gas, for this gas is one of the chief results of their burning.

Even in the worst ventilated room, however, the carbonic acid never rises above ½ or at most 1 per cent. and such

amounts have, by experiments, been shown to cause none of the symptoms of bad ventilation.

So that it is not the large amount of carbonic acid that causes the symptoms of bad ventilation but other conditions presently to be mentioned.

Organic matter.—This consists of particles of animal matter (so small that the eye cannot see them) and also of gases. It is given off chiefly from dirty clothes in a room. Even the clothes we have been wearing during the day, if left in the room in which we sleep, tend to taint the air by giving off organic substances. So, also, people with dirty skins greatly help to make the air of a room unpleasant.

To show how dangerous the effects of bad ventilation are, take this example: If a bird be shut up under a glass bell-jar it will be dead in about three hours. It has poisoned itself by its own poisons.

Further, if instead of waiting three hours, we take out the bird at the end of two hours and put in another bird the latter will die in half an hour or so from the poisonous conditions produced by the former bird.

Air is thus contaminated by the products of breathing; of combustion; of decomposing matter; and by dust and germs.

It is chiefly the heat and water-vapour and, to a perhaps less extent, certain odours given out by people breathing in a room which does not contain enough fresh air that makes the air of such rooms uncomfortable, and have a very disagreeable smell. People who have been a little time in a crowded room do not notice this as their nervous systems get partly poisoned and so their sense of smell is less for the time.

To judge whether a room is "close" or "stuffy"—badly ventilated—*you must come in from the fresh air.* You are then able at once to smell the bad odour of crowded, badly

ventilated rooms as your nervous system has not been already partly poisoned by the bad air of the room. This is one of the best and easiest practical tests of the state of the air in a room.

Animals, such as dogs, oxen, horses, cats, goats, and others, help to poison the air quite as much as men. If their skins or coats are dirty this has the same effect as a man's dirty clothes. Plants in general give out carbonic acid gas at night and oxygen by day. So that plants should not be kept in the sleeping room at night though they are of some slight use in purifying the air by day time as then give out small quantities of oxygen. There are other reasons, however, against having many plants in the rooms in which one lives. Especially because they tend to attract mosquitoes by means of which malaria and elephantiasis are spread.

Domestic pets.—Monkeys are often affected with consumption and are known to have infected human beings with it. Diphtheria has been spread by cats and pigeons; and parrots cause a special disease called psitticosis. Apart from this, such animals use up oxygen and help to pollute the air of rooms.

Products of combustion.—These are mainly carbon dioxide ("carbonic acid") and carbon monoxide. It is very important to remember that carbon monoxide is a most poisonous gas. It is due to it that deaths from charcoal fumes occur when a stove is burnt in a badly-ventilated room. Deaths have often occurred through lighting charcoal stoves in tents closed up sufficiently to prevent enough fresh air from getting in.

On the other hand, carbonic acid gas is not nearly so poisonous as carbon monoxide, as has been shown above.

Germs in air.—The kind and amount are found to depend on the degree of smoothness and dampness of

neighbouring surfaces such as roof, walls and floor ; on the number and degree of cleanliness of the people, animals, &c., inhabiting habitually any confined space ; and on the degree to which the air is heated and charged with dust and water-vapour.

There is no proved relation between the amount of carbonic acid and of germs in air.

Rain washes the air of open spaces comparatively free of germs, and winds act similarly. Direct sunlight is a most valuable purifier of air.

Cause of discomfort in badly-ventilated rooms :

Recent experimental work clearly shows that the evil effects of bad ventilation are not, as was formerly believed, chiefly due to the increase of carbonic acid and to the decrease of oxygen in such air. In the worst ventilated rooms the carbonic acid never increases more than, at the most, one per cent. ; and the oxygen is never lessened by more than one per cent. Neither of these amounts matter practically, for repeated experiments show that it is only when the carbonic acid increases to between 3 and 4 per cent. and when the oxygen is decreased to about 10 per cent. that any real difficulty in breathing occurs.

Thus the degree of chemical purity of the air is not the cause of the bad effects of ill ventilation. Again, it is unnecessary and is undesirable to heat or cool the air to be breathed to any fixed temperature, as was formerly believed.

The good effects of free ventilation are now held to be due to movement and coolness of untainted air, and to preventing the moisture in it from becoming too much. Also, these conditions must be kept constantly changing if ventilation is to be satisfactory.

When the air is too hot or cold or too dry or moist our skins become uncomfortable and this is the first warning to us.

If the skin is not working properly, waste and poisonous substances cannot be got rid of by the sweat. When the loss of heat from the skin is sufficiently interfered with (as when the air is too moist and hot) then we feel uncomfortable and later ill. The skin feels hot and dry. We feel headache and tiredness; and giddiness and faintness are also commonly felt.

Our bodies have a marvellous power of protecting us from carbonic acid poisoning by arranging to keep the amount of carbonic acid in the lungs at a fixed amount. This is done by forcing us to breathe more or less deeply. So when we take exercise, and as a result the carbonic acid produced is much increased, our breathing becomes deeper until we get rid of the excess of carbonic acid.

The bad effects of too much heat or watery vapour in the air we breathe are found to be prevented by cooling the air and causing it to move in currents.

The close, disagreeable smell in badly ventilated air (believed to be due to "organic matter") comes chiefly from dirty bodies and dirty clothes, or furniture. Very little of this odour comes from the breath of people (who are clean and wear clean clothes) and this has been repeatedly proved by experiments.

Long-continued exposure to over-heated and too moist air brings about changes in the working of the body which cause ill-health, feebleness and a lessened power to resist disease. It is found that, in people who take plenty of exercise in the fresh air daily, the evil effects of bad ventilation are prevented or much lessened. But, of course, this is no excuse for living under bad conditions of ventilation. Quite the contrary. It shows, however, the necessity for plenty of outdoor exercise every day, which is one of the secrets of good health and vigour. *Proper ventilation*

throughout both day and night is one of the first necessaries of life.

Cubic space necessary for each person.—This will depend on whether the room is to be used as a working place (as in a factory) or as a dwelling place only.

At least 1000 cubic feet of air space should be allowed for each person occupying the room, *i.e.*, a space 10 feet long 10 feet wide and 10 feet high. The cubic capacity of a room is got by multiplying together the length, breadth and the height of the room. In calculating the cubic space of a room, deduct the cubic space occupied by furniture and do not forget to make some allowance for the number of lamps generally used. The more lamps used the larger must be the cubic space allowed for each person ordinarily occupying the room.

In buildings which are only *occasionally* used and not continuously inhabited (such as religious meeting-places, theatres, schoolrooms and other places of the kind) it is generally quite impossible to allow enough cubic space for the large number of person assembling there. To make up for this the ventilation should be as free as possible. In hospitals a much larger cubic space and the freest ventilation are particularly necessary. In workshops, printing premises, shops, and offices, particular attention must be given to providing as much cubic space as possible and as free ventilation also.

The superficial area should be 100 feet, (*i.e.*, a space of floor 10 feet long by 10 feet wide) *for each person.* And there must also be a height of 10 feet at least between the floor and the ceiling. In this way the 1000 cubic feet required is obtained. (In India, the height from floor to roof should be 15 feet or more for coolness). This 1000 cubic feet is the very least space that should be recommended, especially in India. But this is by itself not

enough, for in order to keep the air moving sufficiently for health this 1000 cubic feet space of air must be changed *thrice every hour.* In this way 3000 cubic feet of air will be given to a person every hour.

For instance, if six people are living in a room then its size would require to be 120 feet long, 120 feet broad, and 25 feet high and the air would have to be changed thrice every hour if the air was to continue to be healthy to breathe. This would mean building very big houses and this would be too expensive for most people.

How is the difficulty to be got over? By changing the air oftener than thrice every hour. For a room containing 500 cubic feet of space for each person living in it, it would therefore be necessary to renew the air six times every hour. In cold climates, such as that of England, or of India in the cold season, this is difficult to do as it is found that if the air is changed *more* than thrice an hour the room becomes too cold and draughty and people are apt "to catch cold" and get ill. One way to get over this difficulty in cold climates is to heat the air before allowing it to enter the room. This is done by making the air as it enters the room pass over pipes containing hot water, or by some such plan. In this way the air is heated without being made more impure by the gases given out by fires, stoves, etc. We shall presently see how this is to be arranged for in India (see Ventilation).

Dangers of over-crowding.—There is very great danger in habitually living in an over-crowded room.

Temporary over-crowding. The bad effects of this are headache, giddiness, fainting, and even vomiting and diarrhœa. If the over-crowding is extremely great, death may result from heat-stroke or from a form of poisoning by one's own self-manufactured poisons and waste matters.

Constant over-crowding. Where people are constantly living in a bad atmosphere—in rooms too small and into

which not enough air can come—then their health rapidly becomes bad. Their general vitality is lowered. This is shown by loss of strength ; sleeplessness ; loss of the desire for food ; bad digestion ; great feeling of unhappiness and of being unable to make any prolonged effort of mind or body. People get pale and "bloodless" from the effect of the poisons circulating in their bodies caused by faulty ventilation and from lack of sufficient oxygen.

People in this state are very liable to get other diseases, such as, Consumption, Inflammation of the lungs or bronchial tubes, Dysentery, Cholera, Plague, Small-pox, Typhus fever, Measles, Diptheria, as well as a severe inflammation of the eyes called Opthalmia which often causes total blindness. Disgusting and troublesome skin eruptions may also be caused. Children are specially liable to severe illnesses as the result of bad ventilation.

In a certain hospital for children in Europe, one out of every three children brought there died from the effects of bad ventilation. When the ventilation was improved the number of deaths in that hospital was nine-tenths less than before.

In one of the finest regiments in the English Army it was noticed that consumption was extremely common. The soldiers in that regiment lived in very small, badly ventilated barracks. When the ventilation was improved and fewer soldiers were made to live in each room it was found that consumption no longer attacked the men as before.

Again, over-crowding is bad otherwise. Children see and hear what they ought not to until they are much older. They are crowded up with grown-up people and privacy and decency are impossible. Enough has been said to show how extremely dangerous it is to live in rooms too small for the number of persons living in them and into which enough fresh air cannot find its way.

When can a room be said to be well-ventilated ? When any person coming in from the open air, finds the air of the room quite free from any smell. That is, when the air inside the room is practically as fresh as the air outside.

Ventilation is the proper renewal of the air of *inhabited* rooms by means of fresh air from outside the room. Ventilation may be *natural* or *artificial.* Natural Ventilation is at work when we open windows to let in fresh air and allow the foul air at the same time to escape. By Artificial Ventilation we mean that we use some special method of changing the air in a room, such as pumping apparatus for sucking bad air out of the room or by driving in fresh air by machinery such as fans.

Natural Ventilation occurs *by the movement of air which follows from one mass of air being more heated and therefore becoming lighter than another.* Suppose we have a room in which several people are sitting. The heat given out by their breaths and bodies heats the air and it expands, gets lighter, and rises to the roof. Colder air then flows in to take the place of the hot air. So, as the air becomes heated and therefore lighter, the colder and heavier air tries to mix with it and flows into the room in order to do so. Further, the hotter the air in a room becomes and the colder the air outside is the quicker does the mixing of the gases occur. This is the reason that when you open the window of a very hot room on a cold night the outside air rushes so quickly into the room.

The closer the temperature of the outside air is to that of the inside air the less the mixing that occurs and therefore the worse the ventilation. This is a most important point to remember especially as regards ventilation in India.

It is due to unequal heating of the air that we have winds. Imagine a portion of the Earth at which the air has been very strongly heated, for example, at the equator

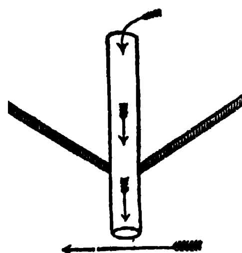
where the sun is hotter than elsewhere. This hot air being lighter rises up and colder air rushes in to take its place and mix with it. The cold air rushing in is the wind.

Winds are a splendid means of Ventilation. They sweep impurities out of streets, houses, and every place where they can enter. And a strong wind has often caused an epidemic of disease to cease suddenly by means of sweeping away the stagnant air containing millions of germs of disease; and also by causing better ventilation of houses, streets, etc., which means greater power to resist disease.

When the wind passes freely *through* a room from one side to the other—that is called *Ventilation by perflation* (which means "flowing through"). It is also called "Cross-ventilation." This is the best means of ventilation. Our houses should have windows and doors nearly facing one another so that the air may enter by those at one side of the room and escape by those at the opposite side.

When screens, purdahs or furniture block up the windows the wind, of course, cannot cleanse the air of the rooms properly. Perflation alone cannot be relied on as the winds change, often from day to day, or cease altogether for days at a time.

Another natural means of ventilation is by *Aspiration.* This means that wind blowing over a hollow tube (such as the chimney of a room) sucks the air out of the tube. More air from below flows up to take the place of the air which has been sucked out and so a constant movement of air—a current—passes from the room up the chimney. In this way also, then, winds act as great ventilating agents—namely, by sucking up the air from



rooms and so removing it. In the same way when a fire is burning in the fire-place of a room it helps greatly to ventilate the room. The fire heats the air round about it and in the chimney. The heated air rises up the chimney and colder air flows into the room to take its place, thus setting up a current of air and changing the air of the room. This principle is also employed by placing lamps or gas-lights near ventilation outlets from a room. We can readily tell in what direction a current of air in a room is flowing by burning a piece of thick brown paper and watching in which direction its smoke is blown.

In all systems of ventilation, however simple or however complicated, we must have an *inlet* by which the fresh air is supplied and an *outlet* by which the foul air escapes.

The *inlets* should be *in general* :—

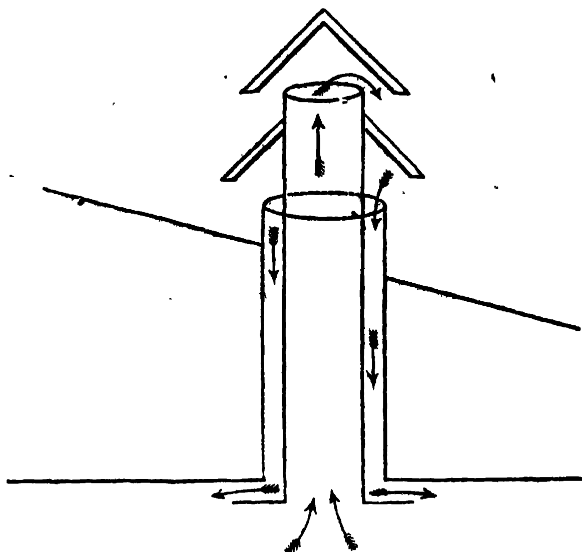
(*a*) Above the level of the heads of the people living in the room for this prevents draughts, etc., from the air in cold weather. Place them 8 feet or so above the level of the floor.*

(*b*) Direct the flow of air through the inlet *upwards* to the roof. This can be done by means of a sloping piece of wood.

(*c*) Have *several* small inlets rather than one or two large ones for this tends to break up the cold air entering the room and not only prevents draughts but cleanses the air of the room better. Bricks perforated with small holes make excellent inlets but the openings on the outer side of the brick must be larger than those on the inner (or room) side.

*But if *heated* air is being used the inlets should be near the floor.

The *outlets* should be in or near the roof as heated air rises to the roof. They should correspond in size to the inlets. Place lamps or gas lights near the outlets to increase the escape of the heated air. See that the smoke and burnt gases from the lights escape by the outlets and do not get



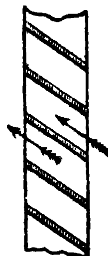
into the air of the room. A ventilation shaft or a chimney must have a cowl to keep out rain and down draughts. Take care that the inlets or outlets are kept clean *and are not blocked up in any way.*

In cook houses there is often no outlet for the smoke. This should always be supplied—for cleanliness, comfort and health.

The figure on this page shows a simple means of combining outlet and inlet by a double tubing, as shown by the arrows.

To apply these principles to Indian houses :

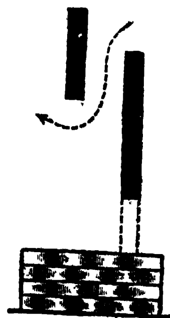
In cold weather, do not close up all windows and doors. Windows in India are often provided with *jhilmils*. When these are opened air passes freely into the room. If there are glass or wooden doors *also* these should be closed as seldom as possible. Close the *jhilmils* instead. Small windows near the roof (clerestory windows) are often used in India. These can usually be left wholly or at least partly open at nights without causing discomfort from draughts. Such windows should be made to open upwards so as to direct the current of air from outside towards the roof.



Keep windows and doors open as much as possible, day and night.

If a window has glass-sashes which can be moved upwards and downwards, open the lower one about 4 or 6 inches at foot and close this open space with a wooden board. The air will enter at the space where the two sahes meet and the air coming into the room will enter as shown by the arrow in the diagram.

Again in cold weather a fire will be an excellent ventilation shaft. *Never close a chimney up in cold or in hot weather* for at all times it acts as a ventilator—more so of course when a fire is burning or when a wind is blowing over its top. Try to get several openings made (*and kept* clean and *open*) near the roof for the escape of foul air. A space for ventilation along the topmost ridge of the roof is a very good plan. Or a space may be left between the top of the walls and the roof.



When the room is empty, open all the windows and doors and let it get well ventilated.

But do not forget that (where the room has doors and windows with *jhilmils* as well as glass-doors) only the *jhilmils* should be closed as air will find its way in through them freely. There should be several small inlets and outlets instead of one large inlet and one large outlet, so as to prevent draughts.

To get rid of dust in rooms, rub the furniture, walls and floors with a duster which has been slightly damped with water. If a dry duster is used the dust does not stick to it but is swept into the air only to settle down again in the room. The Indian servants' plan of flicking off dust with a dry duster is worse than useless. It simply stirs up the dust without removing it from the room. When dust is removed, germs also go with it.

In many Indian houses there are so many doors and windows that there is no risk of bad ventilation if they are left open. If these doors and windows are covered with *chics* or *jhilmils* to keep out glare, heat, flies, etc., the ventilation will generally be quite good. The rooms ought to be as large and lofty as possible.

Remember that cold air does no harm so long as we are warmly enough clothed.

The huts of the poorer classes in India are generally very badly ventilated. There are no outlets for smoke or foul air and if there are they are usually tightly closed up.

In the hot weather, at night, doors and windows should all be left open. In the day time air finds its way in through the *chics* covering the doors. Where *punkas* (or electric fans) are used these do not increase the purity of the air. They only move the air in the room and do not draw in air to any extent from the outside or drive air out of the room.

In hot weather the air outside the house may not be much warmer than the air of the house and so there will be little or no exchange of air going on. It is thus all the more necessary that the rooms should be as large as possible and that the doors and windows be left as much open as possible. The difficulty is that by doing so the hot air enters and makes the rooms very hot. To prevent this, while the weather is very hot, *khus-khus tatties* can be used in places where the air is dry enough and where hot winds are the rule. But in moderately hot weather doors and windows should be left open, night and day, as much as possible. The heat will do far less harm than breathing a badly-ventilated atmosphere.

An excellent plan for fairly-well-to-do people *living in a hot dry climate* is to use a thermantidote, for that sends a stream of fresh cooled air into the room, and thus cools and ventilates it. But the thermantidote must be used so that no draught or current of air from it is felt. Where possible it ought to be placed in a *room opening out of the room in use* and the cool air should be thus allowed to mix gradually with that of the room which is being occupied. Do not sit in the current of air caused by the thermantidote. It causes chills which may mean fever, dysentery, etc. Electric fans are very good and pleasant but are apt to cause chills, especially at night, unless special care is taken. But, if expense permits, *an electric fan along with a thermantidote* would be the best plan of all in a dry, hot climate.

Where there is a *staircase* in a house always arrange to have it well ventilated by a large rain-proof opening in the roof. Remember that the staircase often feeds the rooms with air and also receives foul air from them.

Cook-houses should be well ventilated for, if not, food becomes tainted and unwholesome from the bad air. Do not forget to provide escape holes for smoke.

During sickness in a house good ventilation is more important than ever. Indian people generally close all doors and windows tightly in the sick room. This is the worst thing that can be done as the patient is not only being poisoned by his own emanations but by those of the persons waiting on him. And there is no condition in which a man requires good fresh air so much as when he is ill. In time of sickness do not allow many relatives or friends to come to see and attend the sick man. The writer has often been taken to see a patient into a small room—perhaps not containing 500 cubic feet of air altogether—and in this small space has found perhaps 10 or 12 relatives and friends of the patient sitting for hours at a time. The air was foul and poisonous. Nothing could be more harmful to the patient. He was being poisoned by organic matter and gases given off by his friends' clothes and bodies. Never allow more than one or at most two people to be with the sick person. When a person falls ill and is likely to be ill for even a day or two he ought to be placed in the largest room in the house. He needs all the air he can have to help him to get well again. Now a days, for instance, consumption is treated by keeping the sick person in the open air day and night. He is protected from chill and wet very carefully and is fed in the best way for his illness. Fresh air alone is able to cure most early cases of consumption if combined with rest and proper food.

When we think of how most Indian people shut up all the doors, windows and ventilation-holes in their rooms; how several people go to sleep in the same small room, and how they cover up their faces with a sheet or blanket, we cannot wonder at the feeble health from which so many suffer.

Again most Indian ladies when *travelling in doolies* are shut up so tightly that fresh air cannot get in. After such a

journey, they often remain ill for several days on account of the bad ventilation.

Artificial ventilation—Two chief methods are used: 1. Extraction; and 2. Propulsion.

Extraction. An example of this has been already referred to where lamps placed in outlet tubes were used. Fires are used for this purpose also as in mines where a big fire is lit at the foot of an *outlet* shaft. The heated air rising up this shaft draws the less heated air from other parts of the mine towards it and so carries off the bad air. The *inlet* shaft in mines has a fan at the top of it. This fan is kept revolving and it drives the fresh air down the shaft into the mine again.

Extraction by fans is often used. A fan is made to revolve by being attached to an engine which drives its blades round very fast. The fan is placed at the upper end of a shaft which goes down into the building to be ventilated. By the fan's rotation air is sucked up the shaft and so the bad air is got rid of. Fresh air rushes in through doors and windows from the outside to take its place, or fresh air may be driven into the room by other fans. When air is *driven in* by fans this is called the *propulsion* method.

In ventilating by the *propulsion* method we can cool, filter or wash the air by making it pass through a water fountain; or warm it by passing over pipes full of hot water; and again we can control very exactly the amount of air to be driven into the room. Both these methods of Artificial Ventilation are expensive as fires or lights have to be kept burning or fans have to be worked by engines. They are used mainly for the ventilation of large buildings such as Law-Courts, Churches, Public Offices, Theatres, etc.

Extraction methods work better than propulsion methods as a general rule.

The *thermantidote* is an excellent example of ventilation by the propulsion method. Here air is cooled by being drawn through wet *khus-khus* matting: and then it is driven by a revolving fan into the house.

CHAPTER V.

LOCAL CONDITIONS

Soils. The kind of soil on which we live has a marked influence on our health. Most people know that a constantly damp soil is unhealthy and that such diseases as rheumatism are frequent where people live in houses built on such soil. The amount of water and air that a soil can absorb and hold is therefore of much importance. Some soils absorb much water and yet remain dry, as the water can find its way deep down into the earth where it runs into underground lakes or is forced up to the surface as springs of water.

But if a few feet below the surface there is a layer of rock or of soil which will not let water pass on downwards then the water collects in the upper layers of the soil. Such a soil which is too full of water ("ground-water") is called *water-logged*.

The amount of air in the soil ("ground-air") also varies very much. Ground air chiefly differs from ordinary air in having less oxygen and more carbonic acid gas. The deeper below the surface the more carbonic acid gas there is in the ground-air. There is also less oxygen gas the deeper we go below the surface. The proportion of nitrogen does not differ much from that found in ordinary air. The cause of the increase in carbonic acid is that the ground-air receives much of this gas from the decomposing animal and vegetable matter in the soil.

Ground-air and ground-water are constantly in motion being forced upwards or downwards by water pressing up from below or downwards from rain trickling into the soil and forcing the ground-air and water down. Changes of temperature and of pressure of the atmospheric air, etc., also cause the ground-air and water to rise and fall.

The practical importance of the above facts is that ground air may be forced to the surface at or near the place on which houses are built. If there are any drains which leak or if in any way the ground-aïr has become foul (as by absorption of gases or particles of manure or fœcal matter) this foul air may be a cause of disease. This is especially likely to occur in cold weather when the house is hotter than the ground and when ground air is sucked up into the house. It is, therefore, necessary that we should guard our houses from this source of danger.

If we do not, we are likely to get ill from breathing these foul gases. To prevent these gases from entering the house and also to keep out damp, houses are often built on arches. so that there may be free ventilation *under* the house. Another very good way is to have *pucca* brick floors well covered with cement.

Again, people should never sleep on the ground. They should lie in beds so as to be raised off the ground and thus not breathe the ground air ; and also so as not to be chilled by lying on the cold and often damp ground.

Another good rule is never to sleep on the lower floor of a house if possible. Upper floors are healthier.

Sites for houses. It is important for us to know what are healthy sites and what are unhealthy. We then can take steps to remove unhealthy conditions. Or we may have to choose or build a house some day and then such knowledge is most necessary to us.

We have seen that ground air must not rise into the house. This can be prevented by building on arches or having a pucca cement (concrete) ground floor, 6 inches thick, which should be tightly rammed down. The site should be as dry as possible. This can be got in many cases by good drainage.

The best site is a gentle slope so that both subsoil and



soil may be naturally drained. (Subsoil is the layer of earth lying between the upper soil and the rocks below.)

Where possible, houses should be built on high or rocky ground on a site from which rain water can rapidly drain away.* Where possible the site should be one which dries rapidly—that is, one into which rain water sinks and passes down rapidly into the depths of the soil. Gravels, sandstone, porous limestones and chalks, are specially dry and therefore good. Avoid clay soils as water cannot pass through them easily. If the house gets *damp*, malarial fevers, rheumatism, dysentery and diseases of the lungs and bronchial tubes are more apt to occur.

Sandy soils are very hot unless covered with vegetation which helps to keep the earth somewhat cooler.

Where there is no choice of a more suitable locality, build the house on as high ground as possible and if possible have drains dug so as to lead off rain water and prevent it forming pools about the site. Pipes should be laid in trenches which should be filled in with earth and very small stones or gravel. If necessary place pipes under the site of the house. Such pipes should be made of earthenware which is *unglazed* so that water may get easily through the pores into the pipes.

Avoid marshy or swampy soil.

Particularly we ought to avoid building a house on what are called *made* soils which are hollows in the ground which have been filled up with rubbish and loose earth. Such soils are generally full of organic impurities and are, therefore, very unhealthy. Water-tanks are often filled up and the site is then built on. If this is done, fresh earth must be used and not refuse. Keep the soil round about the house as clean

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*** But the drawback to this often is that *very hard* rocks are difficult to build on.**

as possible. The late Major Grant, Professor of Hygiene, Madras Medical College, gives the following hints as to the sanitation of Native houses :—

"For the repair and maintenance in a state of comparative cleanli- "ness of the ordinary houses of the natives of the country, the "following twelve simple rules should be adhered to: (1) The use "of cowdung as a covering for the floor and walls should be given up: "it is *a dirty habit and an unhealthy one*, for cowdung attracts excess "of moisture and forms a nidus for microbes. (2) Mud floors should "have the *surface dug up and removed every few months*, a layer of "fresh mud, to replace the land taken away, being laid on and beaten "in during dry weather. (3) Mud walls should be left in their *natural "condition internally, or white washed* every four months. (4) Every "room should have either *two windows about 2 ft. square opposite "each other or else one window 3 ft. square opposite the door. "*Windows *must open to the outer air*. (5) In the cook room there "should be some sort of vertical opening or chimney in the roof to "allow of the *ready escape of smoke*. (6) Dirty water and food refuse "should on no account be thrown away in the immediate vicinity of "the house, but *carried to a drain or dust-bin respectively and there "deposited*. (7) The earth round the dwelling should be *well beaten "down* and *a small channel made leading to the ditch or drain at the "side of the road*, for disposing quickly of the rain water as it pours "off the roof. (8) The house should be *opened up as much as "possible, morning and evening*, to allow of free perflation. (9) Its "exterior should be *white washed* as often as necessary to keep it "cool and clean. (10) The latrine must be outside the general "building, with an *impermeable floor* of asphalte or cement, if "possible, *easily accessible from behind* for the sweeper, *cleaned "daily*, and with a door and window large enough to allow of *plenty "of fresh air and light gaining admittance*. (11) Whilst a few plants "and small trees in the neighbourhood of a house are pleasant, there "should be no *interference with the free passage of fresh air and "light to all parts of the dwelling*, and all animals such as cows, "ponies, fowls, etc., should be *separately housed outside the house "and its enclosure*. (12) The occupants of the house should be "*limited to the proper number*, and the unhealthy and objectionable

"practice of letting rooms to various families prohibited." (*Manual of Hygiene*, p. 245.)

It is always best, where possible in a town to do so, to leave spaces formed by filling up tanks as free spaces for air. This also limits over-crowding. Land that has been ploughed up for agricultural purposes is unsuitable if it has been much manured (or spread over with dung).

Avoid all nullahs and hollows and especially hollows in a plain where is stagnant water. Avoid ground exposed to winds blowing over a neighbouring marsh. Where a valley must be chosen as a site, the house should face the direction in which the wind generally blows so long as this wind does not blow over marshy ground. Avoid jungly ground on the banks of rivers, lakes or tanks.

A few trees are an advantage near a house as they protect it from the sun and high winds. But trees must not be *too thick* or they will stop air from blowing freely round the house. Trees should not be *too near the house.*

It may be necessary to plant trees where possible round a house for this has the effect of drying the soil.

The nearness of the site to a good water-supply is a very important point to remember.

Sites on the banks of rapidly running rivers and away from marshes are good. Dry grassy country and ravines or valleys through which a healthy breeze from neighbouring hills blows are also good sites. If near the sea, try to get a site on a tongue of land jutting into the sea.

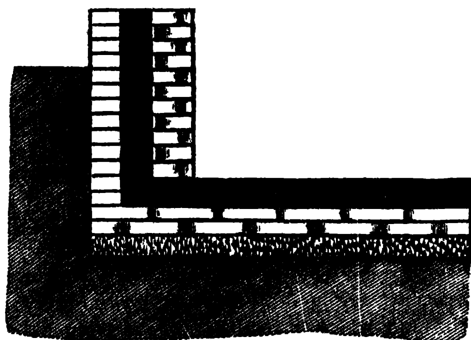
In the case of bamboo or of other wooden houses build the house on piles or stakes of wood so as to raise it above the level of the ground and so as to allow air to blow freely under the house. This keeps it dry and lessens the chance of ground air getting into the house. In waterlogged soils this

is the best plan. Jungle and rank vegetation near the site should be cut down or burnt where possible. Drain and fill up all hollows round about the house.

Where possible it is best to have the house surrounded on all sides by a *paved surface* or by *short* grass which must be cut in the rains and not allowed to grow tall and rank.

Do not forget that *bricks* take up water very freely and that in this way a house may become damp, even if raised on arches. To prevent this a "damp-proof course" should be placed *horizontally* along each pillar of the arch on which the house is built ; or along the whole ground floor if arches are not to be used. The best material to use is slate but that is difficult to get in India. Cement concrete can be used for this purpose.

Do not allow an earth-bank to rest against any part of the walls of the house unless there is a *vertical* damp-proof course in the wall to keep out the damp. (The same remedy should be used where walls get very wet for weeks or months together by being exposed to rain storms.) Remember, that walls may also be damp from broken or leaking gutter-pipes on the roof.



When a house stands near a river which overflows at certain times of the year it is very difficult or even impossible to keep the site dry. The house should be built on a high plinth or platform in such cases.

In India a north exposure is usually best so as to keep the chief rooms cool.

Prepared walls are not so suitable as colour washing* or "distempering." The colour should always be white or light yellow as mosquitoes are known to dislike settling on light-coloured surfaces. Chimneys should be round and straight and smooth inside and should rise a yard or more above the roof.

Roofs should not be of metal or of tiles in hot regions. They should be made double and built of materials which conduct heat badly—slate or cement. They should be coloured white or yellow externally.

Roofs should be high.

There should be free ventilation of the space between the double roofing.

Thatch harbours rats and other vermin† and is very apt to catch fire. But such roofs are good for keeping out heat and are also warm in winter.

Where corrugated or galvanised iron is used the sheets should be placed on boarding closely fitted, or with felt underneath or an earth ceiling should be placed under the roofing.

The floor which is best in every way is one made of good cement. Brick or wooden floors are not to be recommended as being dirty and as the cracks harbour dirt and insects.

In places where malaria occurs, the doors and windows should be closed so as to keep out insects with wire gauze or ordinary cotton netting (painted over four times with a mixture of equal parts of commercial potassium silicate and water to make the gauze less destructible by wet or fire).

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*Silicate paints are strongly to be recommended.

†Close-meshed, wire netting covering to the thatch is useful and not very costly.

The mesh used should be as fine as that used for mosquito-curtains.

Nail the gauze over windows and have (single or double) swing-doors which close themselves by means of a strong spring.

The site should, in short, be dry, fairly exposed to or shaded from (according to whether on the Plains or Hills) the sun, and not blocked altogether from winds. It should be raised sufficiently to allow free natural drainage, and be near a good water-supply.

Influence of swamps or marshes (*jhils.*) The soil in many parts of India is very swampy or marshy, that is to say, it is extremely moist and there are many holes in it filled with water. This is often due to the soil being of clay or of some other kind of soil through which water cannot readily sink. This water is stagnant—it cannot flow away—and such water is the place above all others in which mosquitoes breed and live. (Though mosquitoes *also breed in clear* running water). We shall see later that mosquitoes cause malarial fevers. So we can easily understand how unhealthy are marshes. In fact, malarial fever used to be called "marsh fever" and it is true that marshes are the main places where they occur. Houses should, therefore, as far as possible, not be built near marshes for such houses are always found to be most unhealthy.

Effect of vegetation. *In hot climates* vegetation lowers the temperature of the air but adds to its moistness. The ground is shielded from the sun by vegetation and so remains cooler. At the same time the vegetation takes up much water from the soil. But much of this moisture passes back into the air again. Where there is much vegetation or trees more rain is likely to fall. This is partly because hot moist air drifting over a part of the land covered with vegetation (and therefore cooler for that reason) has its water vapour

condensed and this falls as rain. The people living on land with no trees or vegetation suffer much from extreme heat in summer and great cold in winter and in such bare places usually very little rain falls. In some desert lands no rain falls at any time.

Temperature. *The average temperature of a place* depends on its height above sea level; its nearness or otherwise to the equator; the amount of exposure to the sun's rays (that is, if there is much shade); the prevalence of certain hot or cold winds; the relative quantities of land and water (land gets more quickly heated and loses its heat more quickly than water); and the kind of soil—rocks and sand are hot, and clays are colder. In health, so long as the skin acts freely, the body stands even heat well. But the heat must not be too continuous—that is, there must be cool times of day and the great heat must not go on for months together or the body begins to suffer in various ways. But exposure to great heat while the body is ill or over-tired may cause heat-stroke which is a most dangerous disease in which the person may rapidly die of collapse and extreme exhaustion, or in which very high fever may kill the patient unless very quickly and well treated. Again exposure to the sun's rays when they are most powerful during the day time is dangerous unless the spine is protected by *loose* clothes or a woollen pad, and unless the head is protected by a head-dress of some sort—*puggri sola topi*, etc. In these cases the part of the nervous system which controls our breathing operations (respiration) especially seems to suffer and the person often dies very rapidly when, as the saying is, he is "struck by the sun."

Cellar rooms.—The use of a cellar-room (tai-khana) in hot weather is a bad practice. Such rooms are nearly always very badly-ventilated; and no room should be lived in to which the sunlight cannot freely penetrate so as to purify it. Such dark rooms also tend to harbour mosquitoes.

CHAPTER VI.

FOOD

"Of all pure things pure food is the most excellent."

—Institutes of Vishnu.

" *Moderation in everything is the great principle in life.*"

" *Look to your mouth : diseases enter there.*"

(*Chinese proverb.*)

Food is required to make up for the waste of our bodies caused by living and to supply fresh energy and heat.

The value of a dietary depends on its (1) nutritive value ; (2) heat-productive power ; (3) digestibility ; and (4) cheapness.

Our bodies require to be supplied with :

A. Organic substances :—

1. Proteins (albuminous or nitrogenous substances).
2. Fats.
3. Carbohydrates, that is, starchy and sugary foods.

B. Inorganic substances :—

4. Mineral Salts—such as common salt, lime, iron, sodium and potassium salts &c., and organic salts of fruits &c.
5. Water.

In addition, there is another class called

Food accessories but these are luxuries and not necessities like the five other classes. Tea, coffee, cocoa, alcohol and condiments (pepper, mustard &c.) are the chief examples.

But, in addition to all these, there are a number of substances present in food in very small amounts which have great influence on nutrition. They are termed *vitamines*. Absence or insufficiency of such substances leads to

a form of starvation which causes such special diseases as scurvy, beri-beri, epidemic dropsy &c.*

We must eat the proper proportions of the five classes of necessaries or we cannot keep well and strong. The amount to be eaten varies according to age, climate and as to whether we are using up much energy, heat and tissue by hard work or less by resting or light work. But even when lying still in bed our hearts, respiratory muscles and other internal muscles are using up heat and energy and tissue though not, of course, so much as if we were taking violent exercise or even going about leisurely.

Carbohydrates, Fats and Proteins are required for energy and heat production.

Proteins, mineral matters and water are needed for tissue making and for the secretions.

Carbohydrates (*sugars and starches*) *are specially* important elements of the diet of Indians and other dwellers in hot countries. They are very easily taken up into the system—more completely so than almost any other class of foods. Starches are changed into sugars during digestion and sugars are practically all absorbed : there is no waste. Sugars are converted by the liver into glycogen (so-called "animal starch") which is then stored up in the liver. It is used up from there as needed by the muscles, supplying energy and heat. Some of the fat of the body also comes from carbohydrates and this forms another store-house to be called on when needed for energy and heat production. The carbohydrates also save proteins and fats from too rapid waste in the body.

* The vitamine needed to prevent beri-beri differs from that of scurvy in resisting heat better. Cooking at 130° Cent. destroys the beri-beri vitamine and at 70°C. the scurvy vitamine. Scurvy is cured by giving potatoes, lemons and fresh uncooked vegetables but beri-beri is not. Peas, raw eggs and fresh lemons suit best for beri-beri.

Examples of Carbohydrates.—Bread, rice, sugars, maize or Indian corn, arrowroot, sago, barley, millets, peas, potatoes, beans, lentils, oatmeal.

Fats form fat in the body and produce energy and heat, like carbohydrates. Fats are also derived from carbohydrates and proteins. The more liquid or soft a fat is the more easily is it absorbed by the body.

Examples of fats.—Ghi, butter, olive and mustard oils, beef-fat &c.

Carbohydrates and fats are the best sources of energy for hard bodily work; and protein is only used when they are not available. Carbohydrates are more digestible than fats, but an equal amount of fat yields more energy and heat than the same weight of carbohydrate.

Proteins or nitrogenous foods differ from fats and carbohydrates in containing nitrogen in some form or other. They may be got from animal or vegetable foods—the former being more digestible usually than vegetable proteins. Proteins are the tissue builders. They alone repair the waste of tissue in muscles, brain, blood &c., and are hence often called "flesh-formers."

They also help (but very much less than fats and carbohydrates) to produce energy.

Further, they strengthen the body to resist disease as is shown by the success which attends the use of a liberal meat diet in treating consumption and also that in the Japanese navy a liberal protein diet has been found to prevent the disease called beri-beri.*

Again, during growth of the body, proteins are most necessary in large amounts. But when a person is fully grown it is found that protein is not stored in the body unless

* Vitamines in meat would also help to prevent beri-beri which is probably chiefly due to shortage of vitamines in the diet.

much muscular exercise is being taken at the same time. It is often thought that meat-eaters are stronger than vegetarians but this is chiefly due to other causes—and especially to the amount of muscular exercise taken.

Proteins also are heat-producers and form fat but both to a much less extent than the fats and carbohydrates. They also make the stomach work better, as they specially aid the flow of gastric juice.

Examples of Proteins.—Eggs, fowls, meat, fish, curd of milk, vegetable-albumin as in dal, beans &c.

Mineral and other salts. These help to digest proteins and also aid in making all the digestive juices. Again they are absolutely necessary for blood, bone, muscle, and in all the chemical processes throughout the body by which life is maintained. Iron is found throughout the body and especially in muscle and blood.

The vegetable-salts and those in fruits are most necessary. If deficient or absent then a disease called scurvy results and may prove fatal. Common salt (sodium chloride) is a specially important article of diet. The sodium in it is needed for the pancreatic juice, saliva and other secretions; while the chlorine portion is needed to make the hydrochloric acid of the gastric juice. Salt, however, must not be used excessively as then it tends to cause trouble in gouty and other conditions.

Examples of Salts.—Common salt, lime, phosphates, sodium and potassium salts, citrates, tartrates &c.

Water acts not only as one of the chief elements of every part of the body but carries the food substances throughout the body. It also helps to wash out waste substances from the body and if these were not removed illness and death would soon follow. Water also helps digestion by softening the food, making it easier to digest and to be absorbed into the system.

Besides the water we drink, our food contains much water—about 1½ pints daily being taken thus. From 4 to 5 pints a day are required by the body ordinarily.

Food accessories, such as tea, coffee, cocoa, or alcohol act as stimulants to the heart and nervous system when taken in very moderate amounts. None of these are necessary to life as the other five classes are. But used in moderation, they are all quite useful as supplying variation to the monotony of life. Variety in food and in mental and bodily conditions are very necessary matters, so long as this is harmlessly obtained. The danger is in abusing these pleasant stimulants.

Tea and coffee contain the same active principle (called theine in tea; caffein in coffee). They stimulate the heart and nervous system when taken in small quantities; but, when taken in excessive amounts lead to indigestion, irregular heart action, sleeplessness and to symptoms of nervous irritability and exhaustion. Tea and coffee should not be drunk freely along with a large mixed meal. Never along with butcher's meat. Many people find that tea, and especially coffee, taken even a few hours before bedtime may cause sleeplessness. The habit of taking tea with sweet cakes and especially hot, buttered varieties of bread two hours or so after a heavy luncheon is a great mistake. This extra meal is taken too soon after the previous meal and interferes with its proper digestion. If a *small cup of tea alone* is taken (and nothing solid eaten with it) the practice is usually quite harmless, however. Again, a *small* cup of good coffee *after* a meal may aid digestion, acting as a general stimulant to the nervous system and thus aiding digestion. Tea is made by pouring boiling water on tea leaves. Coffee should never be boiled but boiling water should be poured on the freshly roasted and ground coffee.

Cocoa has an active principle (theobromine) very similar

to that of tea and coffee. It acts more mildly than the latter as there is less of the active principle. It is more nutritious also, as it contains carbohydrates and fats.

Alcohol. *In very moderate amounts*, alcohol is not harmful but in more than such amounts it is a dangerous poison. Alcohol should not be taken between meals, as a rule. Moderation is about one ounce daily of *pure* alcohol, which means about four tablespoonfuls of whisky, brandy, rum or gin; one pint of ordinary ale*; half to three quarters of a pint of light claret, white wine or champagne: or 2 wine-glassfuls of port or sherry. A small amount of alcohol, taken not sooner than dinner during the day, often helps digestion by the stimulation and variety it gives to the meal. It has a soothing mental effect and it also aids the stomach's movements. It further helps to liberate energy (stored up in the nervous system) thus aiding a tired man's digestion very definitely. But it is a very treacherous habit to acquire unless very strict moderation be rigidly kept to.

Children in health never should be given alcohol in any form. Adults do not need it when sufficient food is taken, and, if taken with an excess of food, it is dangerous. Old people who are increasing in weight should never take alcohol (as it tends to help to produce, in such people, kidney and heart troubles; and even bursting of a blood vessel in the brain [apoplexy] with paralysis and often death as a result); but *if losing weight and strength* they may, in most cases, take it, in moderation, with benefit.

Other accessories are *condiments* such as pepper, pickles, vinegar, mustard and other substances used to give flavour or interest to foods. It has been abundantly proved by experiment that whatever increases the pleasure of eating helps very greatly to bring about good digestion. In this

* Beer or ale disagrees with most people living in a tropical climate.

way these accessories are, in strict moderation, very useful aids to diet.

The cost of a food is no guide to its value as a food for the body. Cost depends on scarcity or otherwise of the substance. For example, an equal amount of nourishment can be got from cheese as from beef at far less cost.

Principles of diet. We have already seen that the amount of food we need depends on our age and the climate we live in ; and also on the amount of work we are doing.

Age. Milk is the infant's best food. In childhood, more tissue-building and also energy-giving food is required than in the adult. Proteins are specially necessary for the growing body, and a good proportion of fat and carbohydrates also. In adult life less proteins relatively are needed, as growth has ceased and only tissue repair is required, along with sufficient energy and heat production. In old age, diet must be much less in amount and in heat-producing foods. Proteins should be diminished, water increased, and salts and fats lessened. Carbohydrates in moderate amounts should form the chief basis of old people's diet. Old people should specially eat slowly and little ; and of what experience shows to agree best in the kind of food.

For hard bodily work in adults all the principal classes of food should be increased, especially sugars and proteins.

Climate.—In hot weather, the food must be moderate and easily digestible. Highly spiced food is then more necessary. Proteins should be taken in moderate amount, and fats and carbohydrates lessened. Fruits and fluids are called for naturally and are very necessary.

In cold weather, fats and carbohydrates are specially needed, and proteins also, as tissue waste is greater then.

QUANTITY OF FOOD REQUIRED DAILY.

It is found that man, on an average, consumes daily

1/100th part of his weight as solid food, and 1/30th part as water.

The amounts of each of the food elements taken by Indians doing ordinary work are found to be on an average :—

Nitrogenous food	1½ Chitaks (3 ounces)	a day ;
Carbohydrates	13½ Chitaks (about 27 ozs.)	a day ;
Fats	¾ Chitak (or 1½ ozs.)	,, ,,
Salts	,, ,, ,,	,, ,,

The form in which this amount is taken depends on the race and caste and, of course, also on the age.

In Bengal and Bihar, 2 or 3 meals a day are taken. *The amounts ordinarily taken there* are as follows :—

Boiled rice is the chief article of diet, and an adult eats daily from 12 to 24 chitaks of *boiled* rice ; 5 to 9 chitaks of cooked Dal ; and 3 or 4 chitaks of vegetable curry. Fish is also much eaten in Bengal. Wheat flour (atta) is also used in the form of *Chupattis* and *Loochis*. Meat is generally too expensive for the poorer people in Bengal. With their meals, they drink from ½ to 1 pint of water—and even more in hot weather.

The large amount of water often taken has the effect of delaying digestion as the digestive juices are made weaker and therefore cannot act so well and rapidly. We saw that a certain temperature was needed for successful digestion. Drinking so much cold water lowers the temperature of the contents of the stomach and so still further delays digestion. It is, therefore, the best plan to drink very little when eating, and to arrange to drink any large quantity of fluid, such as water, one hour before food. In this way the stomach will not contain any quantity of fluid which would hinder digestion.

The proper amounts, however, for a grown up person *doing ordinary work* would be 12 chitaks of sugar and

starchy food ; 2 chitaks of nitrogenous food (dal, fish or meat) ; $\frac{3}{4}$ chitak of ghee or butter ; and $\frac{1}{4}$ chitak of common salt.

No hard and fast rules can safely be laid down but we may take as examples the following scales of diet.

A. For Bengalis doing very light work :

Early morning meal :

Boiled rice, 3 chitaks with a little *dal* and vegetable ;

or

Atta (flour) 2 chitaks as a chupatti with 1/12 chitak of salt, with a little ghee and vegetable.

Meal at mid-day :

Rice	5 chitaks.
Dal, fish or meat	$1\frac{1}{2}$,,
Vegetables	2 ,,
Ghee or oil	$\frac{1}{8}$ chitak.
Salt	$\frac{1}{8}$,,
Condiments	$\frac{1}{2}$,,

Meal at night : Same exactly as at mid-day meal.

B. For Bengalis doing hard work :

Early morning meal : as for A.

Mid-day meal :

Rice	6 Chitaks ;
Dal, fish or meat	2 ,,
Vegetables	2 ,,
Ghee or oil	$\frac{1}{6}$ Chitak.
Salt	$\frac{1}{6}$,,
Condiments	$\frac{1}{5}$,,

Meal at night : as at mid-day.

C. For natives of the Punjab, United Provinces of Agra and Oudh, Bihar etc., doing light work :

Morning meal :

Wheat or maize flour	2 Chitaks.
Rice	$1\frac{1}{2}$,,

With a little Ghee and Vegetables	1/12 Chitaks.

Mid-day meal :

Wheat or maize flour	1 Chitak.
Rice	2½ Chitaks.
Dal	1½. ,,
(or if a meat or fish eater 2 chitaks instead of dal).	
Vegetables	2 Chitaks.
Ghee or oil	⅛ Chitak.
Salt	⅛ ,,
Condiments	½ ,,

Meal at night : exactly as mid-day meal.

D. If doing hard work :

Morning and night meals : as at C.

Mid-day meal : 3 Chitaks of wheat-flour or 3½ of maize flour and ¼ chitak of ghee, (instead of as at C).

The rest exactly the same.

These dietaries may, of course, be very greatly varied by introducing other kinds of foods,—eggs, milk, cheese, fowls etc. In practice the more they can be varied the better. For variety in food gives a better appetite for it and also makes us digest it better.

For Europeans a liberal average diet, if living in a temperate climate, would be as follows, according to Dr. Hutchison :

1 lb. bread ; ½ lb. meat ; ¼ lb. fat ; 1 lb. potatoes ; ½ pint milk ; ¼ lb. egg ; ⅓ lb. cheese. This could be taken as follows : morning meal (Breakfast) 2 eggs and two slices of bread and butter.

Dinner : Plateful of potato soup ; meat and meat-fat ; four potatoes ; a slice of bread and butter.

Tea : Tumblerful of milk and 2 slices of bread and butter.

Supper : Two slices of bread and butter and 2 ozs. of cheese.

Brain work does not increase the bodily waste. In other

words the body waste is as little as when doing no muscular work (rest). For brain workers *easily digestible* **food in** sufficient (but not too great) quantities is best. There is no kind of food specially suited to brain-workers. The old idea that compounds of phosphorus were needed is now believed to be incorrect. But a brain-worker uses up much *nervous* energy. So there is less nervous energy to spare to carry on his digestion. Therefore, as little strain must be put on his digestion as possible. Well cooked and easily digestible food in sufficient amount is all that is needed. The nitrogenous foods *in proper amount* are specially necessary to brain-workers and fats and carbohydrates less so.

Rates of digestion of different foods. This depends on the quantity and the solid or fluid nature of the food taken. **Fluids** leave the stomach much sooner than solids. Water, tea, coffee, alcoholic drinks—all will have left the stomach in an hour or less. But if solid food is taken with them then it requires longer. Aerated water leaves the stomach sooner than ordinary water as the carbonic acid gas in it makes the stomach act more vigorously.

Solids. The harder and firmer these are the slower they leave the stomach as a rule. Soft solid food leaves the stomach sooner than hard solid food. Hence thorough chewing is essential. Fish and chicken leave the stomach much sooner than butcher's meat. Cauliflower is one of the most rapidly digested vegetables. An ordinary dinner has left the stomach in about 4½ hours.*

ANIMAL AND VEGETABLE FOODS.

Milk is often called the perfect food as it contains all the five necessaries. A seer of milk contains about one and a quarter chitaks of albumin (the kind in milk is called casein

*** See Appendix III for rates of digestion of various articles of food.**

or curd); and nearly $1\frac{1}{2}$ chitaks of sugar (milk-sugar); about one chitak of fat (butter); about $\frac{1}{8}$ of a chitak of salts; and the rest is water. Carbohydrates in it are relatively less than fats and protein. Milk is not suitable for the whole feeding of adults but it is much the best food for young children. In fact a child should have nothing but milk till it is at least 9 months old. Mother's milk is best of all. If it cannot be got, ass's milk is next best as it is more like human milk than that of the cow or goat. Cow's milk is stronger than human milk and contains too little sugar so it ought to have (boiled) water and a little cream and sugar ("milk sugar" is much best) added to it when being given to infants.

Goat's and buffalo's milks are very often used in India. Buffalo's milk is much richer in cream than cow's, as a rule. Hence it upsets many people, being too rich.

Milk is one of the best foods for old and for most sick people. It is easily digested (in nearly all cases), and is most nourishing. Fresh milk placed in a glass tumbler should have a good white colour. There should be no deposit at the foot of the glass. Its taste should be good and it should have a faint pleasant smell. After some time a layer of cream should rise to the surface. Good milk should yield from 8 to 11 per cent. of cream. This can be tested by having a narrow glass vessel divided into 100 equal divisions by marks on its side. Fill this with milk. On standing the cream rises and if good occupies the uppermost 8 to 11 divisions marked on the glass. Cream is very nutritious, and when taken *in moderate amount* is easy of digestion, except in very hot weather.

Milk must be used as fresh as possible.* If milk is well boiled, covered and then placed in a cool room it will keep

* It has been experimentally proved that the fresher foods are the better digested and more nutritious they are.

longer fresh. *The vessels used to hold milk must be kept very cool and clean or else the milk will rapidly go sour.*

Cholera, Enteric Fever, Dysentery and other diseases may be caused by adding water containing the germs of these diseases to milk. Milk-sellers often add water to milk in order to cheat the people to whom it is sold and so make more money out of the sale.

Consumption is often caused by drinking milk containing consumption (or tubercle) germs got from a consumptive cow.

To prevent milk from carrying disease take care as to the following points :—

(1) Milk should never be taken from a diseased cow especially with sores on its milk-bag (udder) or teats.

(2) The person who milks the cow should be made to wash the hands well before starting to milk. The milkman should wear clean clothes while milking.

(3) Take care that *boiling water* is used *twice every day* to clean out the brass or glazed earthenware *lotahs* or *chatties* used (do not use *unglazed* earthenware *lotahs* as they cannot be kept properly clean). Tin vessels are best of all.

(4) It is safest to boil all milk before using it in order to kill any disease-germs which may have got into it by water *or by dust.**

(5) Remember that even boiled milk will not keep fresh very long. Place in an ice-chest after being got from the cow or after being boiled.

*** *Pasteurization.* The milk is heated at 158° Fahr., for ½ an hour. Boiling is safer. Pasteurization can be carried out by placing a bottle containing milk in a vessel nearly full of water. Then boil the latter, keeping the water boiling for half-an-hour before removing the milk-bottle. Cool the milk then rapidly in the bottle (corked).**

(6) Keep milk in a cool room far away from all drains or latrines which would be sure to poison the milk.

(7) Keep the milk-vessel well covered to keep out flies and dust which may poison it.

(8) Milking should never be done by persons who are nursing sick people. In such cases if the illness is infectious the milk will probably be poisoned by the hands and clothes of the milker.

(9) If you have to add water to milk for infants or sick people, use only *boiled* water.

(10) All vessels in which milk is kept must be particularly clean. When infants are fed by the bottle, two bottles at least should be kept so that when one is being actually used by the child the other may be steeped in cold water (boiled and cooled) so that it may be quite clean. No India-rubber *tube* should be used as it cannot possibly be kept clean and fresh. Steep the India-rubber nipple in water when not in use.

Fresh fish is an excellent nitrogenous food containing also some fat.

Fish from the sea or rivers or clear streams or *fresh tanks* should be eaten. Fish from foul tanks are not wholesome. Eat fish only when fresh and cooked thoroughly. Fresh fish are stiff and firm with no soft spots anywhere. Stale fish have sunken eyeballs, the colour of their gills is not light pink as it ought to be and on cooking it is stringy and watery and not firm.

Oysters are in India to be avoided as a rule, as they often cause illness. Do not eat fish which has been cooked and set aside for some time or which has only been partly cooked.

Tinned or preserved fish is not nearly so good as fresh fish and may often be actually poisonous.

The idea that fish contains a large amount of phosphorous and is therefore a good brain food is no longer believed. It is only a good brain food because it is very digestible and nutritious.

Fish builds up the tissues less than meat. If fish has much fat it supplies much energy. Fish before cooking should be kept in a wire-gauze safe in order to keep flies away from it.

Eggs contain much nitrogenous, fatty and mineral matters, also water. They form an excellent food when fresh. Good fresh eggs sink in a ¼ of a seer of water in which ½ a chitak of salt has been dissolved. Bad eggs float in this solution. Raw or lightly cooked eggs are much more easily digested than when hard boiled, or thoroughly cooked. Eggs make a splendid food for children along with rice and *dal*.

Meat contains nitrogenous, fatty, and mineral elements and water. It is mostly composed of nitrogenous substances and is very nutritious.

Lean beef (that is beef with very little fat) has about 21 per cent. of nitrogenous substance, about 2 per cent. of fat, 1½ per cent. of salts and about 77 per cent. of water.

Fat beef may contain from 5 to 8 per cent. of fat.

Good fresh meat is elastic and firm with a fresh odour. It has a dark reddish-purple colour and if cut into is a little paler in colour than on the surface. If too dark or too light in colour, it is bad. Beef fat should be pale yellow but mutton fat should be quite white. Push a knife into the piece of meat : if it is softer at some places than at others, or if the knife on being withdrawn has a putrid smell, the meat is going bad. There should be no greenish colour to be seen or bad smell for these are sure signs that the meat

is bad and should be thrown away. Eating uncooked meat or putrid beef may cause tapeworm if the meat contains the young of tapeworms. When *thoroughly* cooked beef is safe as the cooking kills the young tapeworms in the meat.

Goat's meat is much used in India. It is somewhat darker and tougher than sheep's meat (mutton).

Pork is a very indigestible food because of the large amount of fat between its fibres. Bacon, however, has the fat more finely divided, so is easier to digest.

Meat should be kept in a wire-gauze or muslin safe to keep away flies &c. It should be hung up in the safe so that air can get freely to it on all sides.

Nations and castes who eat meat appear to be stronger and more vigorous as a rule than those who live on vegetable chiefly. Vegetable eaters have less "staying power" and cannot resist disease so well, and have less muscular and nervous strength as a rule.

Animal food contrasted with vegetable food. In general, the advantages of animal food are a higher proportion of proteins, the smaller bulk of animal food required, animal fats and proteins are more digestible and animal food generally is more appetising and hence more easily digested and usually more thoroughly absorbed. The often-quoted case of horses, oxen and other herbivorous animals is not applicable to man as these animals have the power of digesting vegetable fibre (cellulose) which man has not and their physical requirements are different from those of civilised men.

Fowl's flesh resembles meat in composition (23 per cent. of nitrogenous matter; 3 per cent. of fat; 1 per cent. of salts; and the rest water). It is thus almost equal to beef and mutton in fat and protein value. Young birds are easily digested than old. The breast of chicken is much more easily digested than the legs or than butcher's meat. The

fat of fowls is very apt to turn rancid and is not easy to digest. In the hot season, fowls are usually a more digestible food than butcher's meat which is then very liable to be too tough from recent killing.

Fowls should be killed by wringing their necks (according to the English practice) and not by the much less humane practice of cutting their throats, which also causes them to be less nourishing and juicy through loss of blood.

Fatty foods. Butter or Ghee is the type of such. Mustard oil (or Gingelly seed oil in Madras) is very largely used in India to cook with or to eat along with food. Butter made from pasteurised milk is somewhat tasteless. Good butter is yellow and the depth of colour usually varies with the richness of the pasture. Cows kept indoors and fed on dry food (hay and grain) give usually butter of inferior quality. Buffalo butter is white.

With Indians, ghee is more used than butter and when of good quality is very nourishing and wholesome.

Ghee should be stored in very clean vessels. If not, it turns rancid quickly and is then liable to cause diarrhœa and indigestion.

Cheese is very rich in fat (7 to 30 per cent.) and nitrogenous matters (25 to 33 per cent.). It is often a very good substitute for meat as it is so rich in these. Cheese should not be eaten at the same meal as meat for this means taking usually too much protein. Cheese is best taken at a meal chiefly consisting of bread and butter for it supplies the protein in which the bread and butter are deficient. It is most necessary to remember that cheese needs to be thoroughly chewed and this is best done by eating it with toasted bread or biscuits.

Dahi or milk-curd (prepared in the way familiar to the people of India) is a good material which is rich in nitrogenous matters chiefly.

Vegetable foods are much used by the people of India especially lentils or dal, rice, wheat, peas, beans, millet, maize, barley, green vegetables, and fruits. The varieties of *dal* are several but *chola* (*gram*), *kalai*, *mung*, *masur*, *urhur* are to be preferred. *Mung dal* is especially good for invalids and children. *Khesari dal* ought never to be used as it often causes a form of poisoning with loss of power to move the legs. *Dal* must have its husk or outer covering removed altogether. *Kalai* and *mung* must be steeped well in water before removing the husks.

Dal is generally cooked by itself but often is boiled with rice to form kidgeree (*Kicheri*). When dal has become hard from having been stored for some time, soak it well in water and cook very slowly.

Kalai dal is best for use in hot weather as it is easier to digest.

Dal contains much nitrogen (nearly 18 per cent.), even more so than fish and meat (which average 11 per cent.). *Cold dal or rice which has been cooked several hours before should not be eaten.* It is unwholesome.

Peas and beans and lentils are specially rich in nitrogenous matters, and in carbohydrates also to a less extent.

Potatoes form a most important food-stuff. They have about 20 per cent. of digestible carbohydrate ; 1/5th per cent. of fat ; 2 per cent. of protein and 75 per cent. of water. If a potato is boiled with its brown skin on it is much more nutritious and more easily digested than if boiled after removing its skin. The salts are lost when boiled without its skin. Potatoes in their skins are digested an hour sooner than potatoes without their skins. The potato is a good food for preventing scurvy.

Rice is, of course, one of the most largely used foods in India. In order to get enough nourishment from rice alone very large quantities would have to be eaten and this is bad

for the digestive organs. The stomach, for instance, gets overstretched by these huge meals.

If rice is *boiled* in water the rice grains give much of their nitrogenous matter and salts to the water. So rice water (or the water in which rice has been boiled) should certainly not be thrown away as it contains these nourishing substances.

Rice ought to be at least six months old before use. But it is *better* if it is 1 to 3 years old. Along with rice should be eaten flour of barley, maize, wheat or millets which can be made into chupattis ; and dal, eggs, ghee, fish &c. These are often eaten with rice as curries, kidgeree &c. These other foods are needed to make up for the poorness of rice in flesh-forming and strength-giving substances. Rice ought to have all the red husk thoroughly removed before cooking.

The red husk should not be removed until the rice is one month old. Rice grains ought not to be broken and should be free from all grit. Six chitaks of rice should weigh about 17 chitaks after being cooked.

Good rice of proper age is very easily and thoroughly digested when it has passed from the stomach to the intestines and more so usually than barley, beans, potatoes, meat etc. But *new* rice is very difficult to digest and will cause diarrhœa in most cases. *Atap* (or sun-dried) rice is the most nutritious form. *The outer portion contains most valuable mineral and other vitamine substances* which are removed in *polished* rice grains. This polishing of rice has been shown to be a cause of beri-beri and epidemic dropsy. Rice in cooking ought not to be boiled but steamed for if it is boiled much nitrogenous or mineral matter is lost. Starch forms three-fourths of rice. It is, however, poor in fat (about 1 per cent.), nitrogenous matter (7 per cent.) and salts.

Bread.—This is made from a mixture of flour and water with air or carbonic acid gas (got from the action of yeast) which is then baked in a hot oven.

Good bread should have the following characters :—

(*a*) light and spongy ; (*b*) well baked and brown crusted ; (*c*) no sour or bitter taste ; (*d*) should not be too moist ; (*e*) should not be mouldy ; (*f*) when kept, the lower part should not become heavy and sodden.

The flour used for bread must not be too old, damp or of bad quality. Good yeast must also be used.

Chupattis are made from flour and salt made into paste with water and then cooked. They are not nearly so digestible as is good bread, for the chupatti is tough and heavy, being "unleavened." "Leavened" bread is mixed with yeast (which is not used in making chupattis) and some of the starch is changed into grape-sugar. This last is acted on by the yeast and gives off carbonic acid gas which makes the bread "rise" and makes it lighter and more easily digested. Chupattis made of wheat flour, ground-up dal and ground peas are better as containing more nitrogenous and fatty substances. Chupattis require careful cooking and should not be made too thick. They ought to be light and swollen in the middle with air.

Indian corn (maize) and wheat are generally used as flour, that is after being powdered by grinding in a mill. Wheat flour occurs as *atta*, *maida* and *soojee* principally. Of these *atta* is most used for *chupattis*. *Soojee* and *maida* are also very useful foods. *Loochis* are chupattis fried in *ghee* and are much used.

Cornflour and oswego are made from maize. The fat and nitrogenous matters are removed and only starchy material remains.

Wheat flour should be white or a very *faint* yellow colour. It should have no musty odour and, when rubbed between the finger and thumb, should not be gritty. The flour should be spread out in thin layers in the sun and quickly dried. Old and bad flour is dark brown or a deep yellow colour.

Maize is a good food and also a cheap one. It is very rich in fat: hence it turns rancid easily. Maize is very much attacked by weevils and should not be eaten later than March or April—until the new crop is ready. Wheat and maize are much more nutritious than rice as rice has less nitrogen and fat in it. Wheat has over 9 per cent. of nitrogen, maize has 7 per cent. and rice has only about five per cent. Maize though rich in fat is deficient in Gluten and cannot therefore be made into bread. Rice cannot be made into bread for the same reason. Cornflour, oswego, maizena and hominy are all made from maize: in the first three, starch is the chief substance left but in hominy there is more nitrogenous matter than in the others. *Arrowroot* contains 82 per cent. of starch and scarcely any nitrogenous or mineral substance. *Oatmeal* is specially rich in fat and is otherwise very nourishing. If manufactured by rolling (and not ground and heated while rolling) it forms a more digestible food. Gruel (boiled oatmeal in water or milk) or porridge (made by stirring meal into boiling water and cooking to thick consistency) are favourite preparations made from oatmeal.

Green vegetables contain about 90 per cent. of water, 2 of nitrogenous matter, about 4 of starchy matter, about ½ per cent. only of fat, and a marked quantity of salts. They may be classed either as anti-scorbutics (that is preventers of scurvy) or as having little or no anti-scorbutic action. Raw vegetables are apt to convey worms (round or "thread" worms), enteric fever, cholera etc., unless well washed in

good water before eating. The washing should be repeated four or five times, using fresh water each time.

Good anti-scorbutic vegetables are potatoes, onions, brinjal, lettuce, carrots, parsnips, mangel-wurzel, artichokes, cauliflower, cabbages, radish, tomatoes, yams, beetroot, asparagus, celery, haricot, beans and peas.

Of little anti-scorbutic value—pumpkins, melons, vegetable marrow, gourds, spinach and *sag*.

Spinach, however, is rich in iron salts and is an excellent blood-former. It should, therefore, be given to pale and bloodless people especially.

Avoid too stringy and tough vegetables as the fibres cannot be digested and thus irritate the bowels.

Fresh vegetables are firm and crisp and break off short when bent.

They should always be eaten as fresh as possible and as soon as possible after being gathered. They must be well cleaned with clean *filtered water* or better still with boiled and cooled water.

The potato is an excellent anti-scorbutic. Chutneys and pickles are good anti-scorbutics. Chillies help the digestion of large meals of rice and *dal*. Lettuces used as salads are good anti-scorbutics but require to be specially carefully washed and should never be eaten unless grown under conditions excluding manuring or other such contamination. In India, they are always suspicious articles of diet. *Onions* contain a very high proportion of phosphates and sulphur compounds and have with some people a slightly laxative effect on the bowels. They are good anti-scorbutics and are useful for people suffering from boils or rheumatism.

Cauliflowers are specially easy of digestion and are rich in proteins.

Fruits contain much sugar and some acids which give them their pleasant taste. They are not of much value as

foods as, if taken as the chief food, a sufficient amount of them could not safely be eaten. Limes, mangoes, baels, papias, tamarinds, *anchur* are very good anti-scorbutics.

The plaintain is cheap, but not very rich in carbohydrates and it has but a small quantity of nitrogenous matter. It cannot be used largely as a food as it is too bulky. About 60 a day would be needed to supply the necessary energy for the body and a very much larger quantity in order to get enough nitrogenous substance. So it is of low nutritive value by itself. *Banana flour* is of very nearly as little nutritive value as rice. A kind of bread can be made of it. Do not buy or eat fruit that has been cut open and laid down, as dust containing disease-germs may have fallen on it and poisoned it.

Dried dates and figs are very much more nutritious than bananas.

Fruit must be eaten when ripe and quite fresh. Fruit should always be well washed before being eaten. Do not eat bruised or over-ripe or rotten or unripe fruit as such causes diarrhœa and may predispose to Dysentery or Cholera. Uncooked fruit should be eaten *at least* once a day. It is not its actual food value that is important. But it contains most important salts which the body needs for its proper working. Fruits, besides being usually good anti-scorbutics, help to keep the bowels regular. They are naturally craved by the body in hot weather especially. This tendency acts also to some extent as a check on over-eating heavier kinds of food which are less suitable during heat.

Tinned fruit is not nearly so good as fresh fruit and may cause poisoning from the metals (lead, copper, arsenic, tin, etc.) which compose the vessel or by the fruit itself being of bad quality. Tinned foods are very deficient in vitamines.

Cooking should be carried out in the cleanest possible

manner.* No food should ever be placed on the cook-house floor for an instant. Meat, fowls, fish etc., should be cleaned on a clean table. Cooking vessels should be washed with clean *drinking water*. Dirty water or water which has already been used for washing vessels should not be used for this purpose. A cook-house should have its windows and doorway covered with fine metal gauze-netting or bamboo chiks which keep out flies but yet allow of ventilation. Flies are one of the most dangerous sources of contamination of food.† Flies can often be seen coming straight from a foul drain and crawling on food. Uncooked food in the kitchen should always be kept cool and covered to keep out flies. Huqas and dirty clothes should never be allowed in a cook-house. The kitchen should have no stagnant pools of water on its floor. The floor should be of cement without holes and depressions in it in which water can collect. All fragments of stale vegetables, fruit, meat etc., should be collected in a vessel and taken to a distance and thrown away. Such scraps should never be allowed to lie about the floor. The kitchen floor and tables should be well washed daily. Lastly, the Indian habit of cleaning cooking pots with earth is very insanitary. In this way filth thrown on the ground is rubbed on the cooking vessels.

The cooking pots. If copper degchis are used they ought to be tinned every 2 or 3 weeks. If this is not well done, copper poisoning may occur. No green stains should ever be seen on a copper vessel. The green stain is a very poisonous substance. Aluminium pots are expensive but they are safer to use than copper pots. Earthen pots are

* "The cook shall not speak nor cough nor spit while his face is turned towards the food."—*Apastamba*.

† "Let him never eat food given by a sick man nor that in which hair or insects are found nor what has been touched by the foot.....nor the leavings of another man, nor that on which anybody has sneezed."—*Manu Sanhita*.

most used by Indians but should be *well-glazed* and change frequently.

Hours for meals. These must depend on the day's work and on other reasons. Young children require to be fed every three hours and grown up people should eat a moderate meal every five hours. If people are ill or delicate the food should be given *a little at a time and more frequently*. The food for sick people must be very light and easily digested. Milk is one of the very best, if it agrees.

Indians usually have two large meals a day—at noon and at night. The objection to this is that the stomach is over-filled in most cases and constant over-stretching gives rise to disordered digestion especially in middle life and old age. But if these two meals are only moderate in amount this plan is a very good one for both Europeans and Indians.

The periodic religious fasts are based on very sound principles. Most well-to-do people eat far more than is good for them and an occasional rest, by fasting for a day or even missing one meal, is most beneficial.

Many cases of indigestion, which have defied medical treatment with drugs and diet for years, are rapidly and permanently cured by the simple means of resting from food (but drinking freely of water every two or three hours while so fasting) for a day or so. And then, instead of three *large* meals a day, take one very light meal in the early morning ; a light mid-day meal (from which one rises feeling satisfied but not over-loaded in any way) and a sufficient but not excessive meal in the evening. Everyone has to try to find out what suits him best.

The writer considers that a large number of cases of indigestion result merely from the fact that the stomach is not quite empty when a meal is taken. This usually means over-eating at a previous meal. So long as any food remains in the stomach it is impossible to have a healthy appetite,

followed by good digestion. So that nothing is more important than that one should only eat when the stomach is empty for then alone can the stomach properly digest food.

The great guide is—*never eat unless really hungry,* (as shown by the mouth watering at the sight, odour or thought of food). If you have no hunger at a mealtime, miss that meal ; and then by the next mealtime you will probably be hungry.

As to eating we should try to eat neither too much nor too little. To rise from a meal not fully satisfied is better than to rise feeling we have eaten too much.

The amount of food, it has been seen. chiefly depends on the work done.

As people get older they ought to eat less. They do not need so much food for they are generally doing less hard work and taking less exercise. Besides, as they get older, their digestive powers become weaker and so they can digest much less food.

It is a very bad plan to eat a heavy dinner only an hour or two before going to bed. During sleep digestion is somewhat feebler. At least three or four hours should elapse between a heavy meal and going to bed.

Refer also to the rules already given in Chapter II. Remember the necessity for well chewing all starchy foods especially. Well-chewed food is much more enjoyed and is also much more easily digested. When food is thoroughly chewed and mixed with saliva a much smaller amount is craved—the appetite (espeically for flesh-food) is more easily satisfied. To every person but, above all, to people with weak digestion or poor general health, thorough chewing of food (and mixing well with saliva) is one of the most important rules to follow. This alone often leads to greatly improved digestion and better general health as the absorption of food is greatly increased.

Food should not be allowed to stand long after being cooked but should be eaten *as fresh as possible.** Leaves are often used instead of plates by Indians. It is best not to do so unless they are very well washed first. The same leaf should never, at any rate, be used twice for food.†

Food should always be eaten out of a separate dish. (It is forbidden for more than one man to eat out of one dish—*Mahabharata Anushasana Parva*). Several people should never eat out of the same dish for the reason that if one has dirty hands he may poison the food for all the others. The hands ought to be washed before eating. The nails should be kept short and clean as disease-germs are very likely to get under the nails if they are dirty and may thus be swallowed along with food.

Meat-eaters should remember that, *in hot weather*, meat should not be taken more than once a day *as a rule*. Fish, fowls, fruits, vegetables and such birds as quail, snipe, teal, pigeons are better during hot weather than "butcher's meat" as being more easily digested.

Meals should be taken at the same time every day for the stomach and bowels get into habits and act better and with less effort when the food is supplied at regular intervals.

The room in which food is eaten should be well ventilated and quite free from the smell of previous meals which tends to destroy the appetite.

Pure water is the best drink of all. Aerated waters, such as soda-water etc., are also good as giving an attractive

* "He shall not eat food which has been obtained ready cooked in the market.

Prepared food which has stood for a night must neither be eaten nor drunk. Nor if it has turned sour."—*Apastamba.*

† "He must not eat from a dirty dish, not lying on the ground, not having placed the food on the ground. He must not eat substances from which the fat has been removed. Nor must he eat, at night, sour milk."—*Institutes of Vishnu.*

character to water on account of the carbonic acid gas. The tendency is to consider aerated waters as safer than ordinary water but this is not necessarily so. If the aerated water is procured from a reliable source where care is taken to use only pure water then, of course, this is a great advantage. But aerated waters from a source which cannot be relied on may carry disease.

The carbonic acid tends to destroy cholera germs (as do other acids), but requires a few days to do so, according to some writers. As regards other germs, the writer's (unpublished) experiments some years ago showed that the more recently made the aerated water was, the greater was its restraining action on germ-development.

EFFECTS OF EXCESS OR DEFICIENCY OF FOOD.

Excess of food produces indigestion, flatulence or wind, biliousness, giddiness, sick feelings, constipation or (by irritating the bowels) diarrhœa, and headaches. It makes people sluggish, stupid and lazy. It causes them to become, in many cases, fat and clumsy. Eating large amounts of sweetmeats, rice and ghee (and taking little or no exercise) are in India the cause of extreme fatness. Besides the sugar cannot be used up by the body and appears in the urine. This in time may lead to diabetes which is a very fatal disease—especially in young people. Gout is often caused by eating too much food.

Deficiency of food. *Starvation*. A starved person becomes weak and unable to exert himself in any way. He has no power of doing work except for very short periods. His resistance to disease becomes much less.

He becomes thin and pale and bloodless. He tends to weep too easily. He later becomes very weak-minded and stupid. He may die of exhaustion. A person dies when

completely deprived of food and water for 8 or 10 days but, if he can get water, he lives much longer.

Most food is needed in youth and more nitrogenous food should be proportionately taken then than carbohydrates. Tissue and heat-formation demand this. If a man is deprived of *nitrogenous food* for long he loses strength and becomes pale and bloodless. If deprived of carbohydrates this is less felt if much fat be given. When both carbohydrates and fat are not given in sufficient amount ill-health very quickly results. If salts and fats are not taken illness soon follows.

Hard brain-work calls for plenty of easily digested food—proteins chiefly, and less fats and carbohydrates.

Hard muscular work requires a liberal mixed diet.

When leading a sedentary life, fats and carbohydrates should be taken in smaller amounts than otherwise. In hot weather, more vegetables and fruits and less meat are needed. In cold weather more nitrogenous and fatty foods are required.

As a rule it is found that young people err on the side of taking too little food. Old people again are very apt to take too much.

At the beginning of this Chapter reference has been made to diseases caused by the absence of vitamines or other constituents of food necessary for proper nutrition. The amounts of these required are usually very small but if they are absent from the food grave disease results in time. Fresh uncooked foods are the chief sources of vitamines.*

Condiments are used to increase the flavour of food and so the appetite for it; and also to help digestion. They thus

* Especially fruits, oatmeal, peas, haricot, beans, raw potatoes or lemons, fresh uncooked vegetables, yeast, milk, fresh meat and raw yolk of eggs.

make us eat more than we would otherwise do. *They may cause irritation and greatly upset the digestion if too much of them is taken.*

Young children never need condiments which should never be given to them.

Condiments are great aids to digestion in India where large quantities of such foods as rice etc., are taken. Salt, chillies or red pepper, vinegar, cardamoms, black pepper, peppermint, cloves, ginger, lime-juice, mustard etc., are used as condiments.

They also help to expel wind from the stomach and bowels : and ginger, cardamoms, peppermint, cloves etc., are given as remedies for flatulence. Pickled mangoes, tamarinds, dried plums, and other sour fruits are also much used as condiments.

Effects of unwholesomeness; and diseases connected with Food.

Fish. Certain kinds of fish, even when fresh and in a healthy condition, are poisonous to man especially if their intestines, head or liver be eaten.

But fish of a wholesome kind should always be eaten as *fresh* as possible, for fish goes bad quickly. It is particularly likely to become poisonous when cooked and kept for some time. This is why fish "preserved" in tins or dried, and certain kinds of shell-fish are so poisonous at times. Shell-fish (oysters, etc.) may give cholera through having themselves eaten food containing cholera-germs. But *well cooked* fresh fish is safe. Again one kind of tapeworm may be got from certain kinds of fish unless *thoroughly* cooked. Smoking or drying the fish will not kill this tapeworm. Oysters, lobsters or salmon when tinned often give rise to poisoning. Some people cannot eat shell-fish, however healthy the fish may be, without being made ill.

Oysters from Bombay have often caused enteric fever when eaten. In such cases the oysters have fed on *faces* containing the germs of this disease.

Meat which has "gone bad" (that is turned putrid), or which is diseased, or which has been poisoned by the animal having eaten poisonous stuffs may cause severe illness or even death. Vomiting and diarrhœa and other symptoms may be caused by eating meat kept too long before being cooked,—especially in the hot weather. Tubercle or consumption is believed to be caused at times by eating the flesh of animals having that disease. Goat or sheep's flesh, if diseased, should never be eaten.

The Muhammadan, Hindu and Jewish rule not to eat pig's flesh is a good one, generally speaking, for in India pigs are very dirty eaters and eat all sorts of filth which may poison the meat. When in the form of ham, sausages or cold pork it requires to be most carefully prepared as these forms are specially likely to give rise to poisoning. But well-cured (smoked) hams or bacons are excellent foods when (as in England) the pigs are fed on good food and not allowed to eat filthy food and are kept under sanitary conditions.

Sausages made from pork have caused many fatal cases of poisoning.

Tapeworms may be got from the flesh of the pig and of the ox but *thorough* cooking kills them. (A temperature of 140° Fahrenheit *certainly* kills the tapeworms if exposed to it for 5 minutes. The temperature in cooking is generally well over 150° Fahr.). Salting and smoking does not kill them. Another disease produced by eating pork and sausages is caused by small worms which get into the flesh (muscle) of the pig producing symptoms *at first* like cholera in some cases or like enteric in other cases. Later on the patient's muscles get very sore and tender from the worms

burrowing into them. *Thorough* cooking will prevent this disease as the worm is killed by cooking at 150° Fahr. If the pork keeps its blood-red colour like uncooked meat the temperature has *not* reached 150°. Two hours of good cooking of a moderately sized joint of pork will make it quite safe.

Flour if sour (as is old, bad flour) causes diarrhœa and indigestion.

Old flour is indigestible as a rule.

Badly baked chupattis or bread cause severe indigestions.

Wheat flour occasionally (not often) may prove poisonous because of diseased rye-flour being mixed with it. This disease is called Ergotism and is caused by a disease of that form of rye called the "spurred eye." This disease is caused by a small fungus (or parasitic plant) growing on the rye.

Bread has caused poisoning by having alum and lead mixed with it but such cases are *very* rare.

Sugar is one of the best muscle foods. It is very fattening. It is apt to cause indigestion if taken in too large amount. The continued use of too much sugar causes diabetes or predisposes to it.

Oats. Oatmeal causes diarrhœa and indigestion in some people as the husk of it irritates the stomach and bowels.

Maize or Indian corn (mukka). If bad grain is used it may cause a disease called Pellagra which affects the skin, stomach, bowels, and nervous system.

Millets (bajra, cumboo) are very largely used in India as food. They are very wholesome and are not apparently adulterated to any extent.

Milk when impure is one of the means by which much illness is caused in man. If the cow is diseased then consumption, foot and mouth diseases, anthrax and other diseases may be caused. Cows should be kept in dry, airy quarters

and be well fed and cared for. As cows are very liable to consumption and as tests made show that a high proportion of cows have the disease and that their milk contains tubercle-germs, all milk should be considered as possibly tuberculous unless the contrary can be shown by tests.

But one of the greatest dangers to health is caused by adding foul, disease-bearing water to milk. It is quite certain that cholera, enteric fever and diarrhœa can be caused in this way and this is a very common way of getting these diseases. Again milk may be poisoned by gases and particles of dust (with disease-germs on them) from the air. If a latrine or drain or any other foul place is near the place where milk is stored there is great danger of the milk becoming poisoned by gases, dust or flies.

Again, milk may become poisonous, if filthy vessels be used or if the milker milks with dirty hands. Cholera, Enteric fever and Diptheria have often been given by these means.

Dahi and Ghee, if rancid, may cause indigestion or diarrhœa. If made from milk poisoned with disease-germs ghee is not likely to cause disease because it is strongly heated when being made.

Butter may cause all the diseases that milk may cause if made from milk which has been infected with disease-germs. (It is not heated while being made as ghee is).

New rice (under 6 months old) causes diarrhœa and under certain conditions dysentery, especially if the husk has not been entirely removed. *Polished* rice-grains may cause beriberi and epidemic dropsy, under certain conditions.

Fruits. When over-ripe, rotten, or unripe they may cause diarrhœa and may predispose to dysentery and to cholera if it is in the neighbourhood. Such fruit ought to be most carefully avoided when cholera is about, indeed it is safer to eat no fruit at all in cholera times.

Preserved "tinned" and dried fruits may also cause diarrhœa and indigestion or more serious illnesses from the fruit itself being of bad quality or from any poisonous metals used in the tins. In both fruits and vegetables, bottling is better than drying or preserving in tins. Fruits are often preserved in syrup.

Vegetables which are *eaten uncooked* may, unless thoroughly washed with pure water, cause disease just as fruit does; for example, lettuce, tomatoes, celery, and parsnips. Old vegetables with stringy fibres cause indigestion and diarrhœa. Stale or dried vegetables lose their anti-scorbutic action.

Preserved Foods Generally. *Frozen meats* are generally safe enough if well cooked. Drying or Salting does not kill parasites in food so preserved. Such foods require very careful cooking. They are somewhat more difficult to digest than fresh meats.

Milk is often preserved by adding boracic acid, "formalin," benzoate of soda, and other chemicals : this is a bad and unwholesome way generally. Milk dried to a powder is sold as various patent foods. The proper way to preserve milk is to cool it sufficiently by keeping the vessel in which it is placed surrounded with ice or a mixture of equal parts of salt and ice.

Tinned milk may cause illness. Remember that when a tin of condensed or tinned milk is opened it rapidly goes bad. Much sugar is added to many forms of such milks and preserves them in the tin but when the tin is opened and exposed to the air the milk goes bad shortly after. As regards tinned foods, *whenever gas or a bad odour escapes from the tin on opening it* the contents are bad and must be thrown away. If the sides of the tin are bulged out by gas it is dangerous to eat the contents. If foods are badly preserved, then they are extremely dangerous and may cause death

from poisoning, often with symptoms like arsenic poisoning or cholera. This is called *ptomaine poisoning*.

Meat may be preserved by "salting" it. Powdered salt or salt and nitre are rubbed into it. Or meat may be salted by steeping it for some time in salt and water—"pickling"; or by keeping it frozen; or by tinning and boiling it and closing up the tin while the contents are boiling freely. (This is how tinned Australian Beef and Mutton are preserved and this method preserves the meat very well.) Again by adding preservatives meat may be preserved (this is a bad method to use) as is also the plan of injecting chemicals such as salicylic acid, alum, &c.

Butter is preserved by adding sufficient salt to it; or, better still, by boiling it and then *bottling* it while hot.

ADULTERATION OF FOOD.

The following are a few examples of adulterations of food.

Milk is mainly adulterated by adding water. The danger of this has been already pointed out. Other forms of fraud are removing the cream; or both of these frauds may be carried out at the same time.

It is rare for other substances to be added to milk in order to adulterate it. Starch flour may be added to thicken the milk. Glycerin, carbonate of soda, boracic acid, salicylic acid, sugar, common salt, formalin, etc., may be added to preserve it. Nearly all of these are injurious, and some of them dangerous.

Flour of various kinds may be adulterated by adding cheaper kinds of flour; also sand, rice or potato-starch, etc.

Ghee is very frequently adulterated by adding water and working the ghee up with it; also by adding vegetable oils—poppy, *mowa*, ground nut, cocoanut, etc.,—or by adding the

fat from beef or mutton. Much of the ghee sold in Indian bazars is adulterated to some extent. *Butter* may be adulterated in the same way by working water up with it and also by adding animal fats; and plantains have been found worked up with butter. Margarine or artificial butter is often fradulently used in Europe to mix with butter.

Lard is often adulterated in the same way as butter, and largely also with common salt, etc. The writer has had a case sent to him for analysis in which 50 per cent. of salt had been added.

Tea is frequently adulterated by mixing it with leaves which have been already used (and which are therefore called "spent" or "exhausted") or with leaves of other plants.

Sugar is mainly adulterated with sand.

Bread may be adulterated with alum. The alum is added in order to whiten the old, yellow, bad flour which is used (as being cheaper).

Sweetmeats are often adulterated in India with rice finely ground up. Bad sugar or ghee, or flour are also often used; and sand, etc., is occasionally added.

Oatmeal is adulterated by adding the ground-up husks of other cereals; and rice or maize.

Mustard oil is largely adulterated with other cheaper vegetable oils.

FOOD IN USE IN NATIVE HOUSES.

The more important are: Meat, (*Kabobs*, meat roasted in lumps); fish; vegetables; rice and *dal*; fruit; milk; *gur*; sugar and parched grain; bread; chupattis; *Kachowri* (cakes of pulse and wheat flour fried in ghee); *gulgulla* (small balls of flour fried in ghee or oil); liver and rice; mashed pulse; wheat-bread mixed with sugar; butter-

milk; ghee; *kidgeree* (*kicheri*); sweatmeats; *dahi bara* (dal cakes fried in fat and soaked in milk-curds); *panjiri* (fried mixture of flour, ghee, and sugar flour cakes); *halwa* (a pudding of soojee, ghee and sugar); mushrooms; dahi (sour curds of milk); *chenna* (casein of milk) made into different foods with sugar; pillao (chicken or goat's meat boiled with rice and ghee and condiments); *payesh* (rice boiled with milk and sugar); and other too numerous to mention. Many other foods have already been discussed. Greasily cooked foods are difficult to digest and should never be taken by people with feeble digestions.

So *Kachowri, gulgulla, dahi bara, panjiri, halwa* should only be eaten in moderation by people in health and not at all by sick people or by those whose digestive powers are not good. To sweetmeats the same advice also applies. Foods with too much pepper or chillies are too irritating for the stomach and also cause liver disorders.

Mushrooms are rather difficult of digestion and not very nutrious. Great care must be taken that mistakes are not made in choosing mushrooms. There are many *toadstools* which may be mistaken for them and which are very poisonous. Over-ripe or too soft mushrooms are dangerous. If the mushroom has a bad taste or smell it is dangerous. Do not eat mushrooms which have been growing near manure heaps or in damp shady places, or which have a bright colour, as such are often very poisonous. Cooking does not prevent the danger of poisoning in the case of poisonous mushrooms.

CHAPTER VII.

DISEASE.

Disease may be prevented in two ways :—

(1) By learning how to keep the body healthy by attention to the supply of air, water, food, suitable clothing, and by living in healthy houses.

(2) By finding out and removing the causes of diseases. Now, these causes may be (*a*) *predisposing* : that is to say, our health may be for the time lowered from some cause and this makes us more liable to get any disease, for we cannot resist it so well. Again the cause may be (*b*) an *exciting* one, that is the cause which actually gives us the diseases ; as, for example, swallowing cholera germs in water or milk.

Now a man may be predisposed to a disease (that is, likely to be unable to resist it) and yet escape because the *exciting* cause is absent. For instance, a man is over-fatigued and badly fed. He is, therefore, likely to get (that is, he is predisposed to) such a disease as cholera. But if there are no cholera germs about to find their way into his body he will naturally not get cholera.

Take another case. Many people go through a cholera epidemic without getting it. Why ? Because they were not predisposed to it or because they did not happen to come in the way of cholera-poisoned water, dust or food ; or by taking great care of their health they prevented any cholera germs from entering their bodies.

You see that these two causes are distinct. But if both are present at the same time and place, the chances are great that disease results.

PREDISPOSING CAUSES OF DISEASE.

1. **Unhealthy conditions of life.** If people are living in badly ventilated rooms, are badly fed and drink bad water, are badly clothed, are doing heavy work and are therefore tired out, they are extremely liable to get any disease that is about.

People who eat too much food or take in excess such drugs as opium, alcohol, cocaine, Indian hemp, etc., also are very likely to get diseases of certain kinds.

Unhealthy occupations act in the same way for in these we have people living in overcrowded rooms with perhaps heavy work and too little food.

2. **Age and Sex** also predispose to certain diseases. The reason of this is that at certain times of life certain organs are more active than others. For instance, a very young child and a man are both exposed (in a temperate climate) to a severe chill : the child will probably get a bowel disease such as inflamation of the lining membrane of the bowels, but the man is more likely to get a chest disease (inflammation of the lungs or bronchi).

Again children suffer more from infectious diseases, that is to say, diseases that we get by coming near people suffering from such diseases. This is the case in such diseases as small pox. The reason of this is that children when they first meet the poison of the disease get the disease. Older people have met the poison and got the disease years before and so they are much less liable to take it again. This, then, explains the fact that children suffer more from infectious diseases than grown up people.

As regards *sex*, certain diseases tend to attack males more than females ; for example, diabetes, gout, tetanus (or lockjaw), etc. Again, females more often suffer from ulcer

of the stomach, goitre (a swelling of a gland in the middle of the neck), neuralgia or pains in the nerves, etc.

3. **Heredity**. The children of parents who have had such diseases as cancer, consumption, gout, etc., are particularly liable to get these diseases too. Special care is needed to guard the health of these people at the time of life when such diseases are likely to come on.

EXCITING CAUSES OF DISEASE.

These may be of many kinds—for example, great heat or cold, poisons taken into the body by swallowing or otherwise, or poisons formed in the body itself as in gout, etc.—but those which we have to consider now are diseases caused by animal and vegetable parasites. What is a parasite ? It is a living creature which lives at the cost of another (called the host because he feeds the parasite just as a host feeds a guest).

The chief kinds of parasites we have to fear are germs or as they are also called micro-organisms or microbes (which means *little living beings*). These germs are so small that they cannot be seen with our eyes. How, then, can we know of their existence ? We can not only see them by the aid of the magnifying glasses of a microscope but we can catch them and grow them just as a gardener grows vegetables in a garden. The study of germs is called *Bacteriology*.

Now germs may be divided, for our purpose, into two kinds :

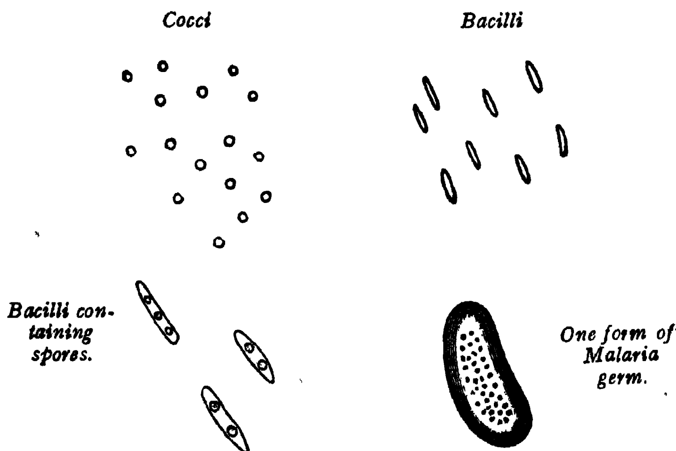
(1) Harmful (also called pathogenic or disease-producing) ; and

(2) Harmless.

These germs, whether harmful or harmless, may have

different shapes—round or oval (cocci*); like short rods (Bacteria or Bacilli†) which may grow long and form straight or curved threads (leptothrix‡). *Curved* rods which are either single or in a *spiral* thread are called Spirilla.

There is another kind of microscopic parasite called a Plasmodium. This is somewhat different from the other kind of germs above mentioned. Malaria is caused by a Plasmodium.



Some of these germs can move by themselves actively from one place to another. Others cannot move but are carried from one place to another by any force from outside them, so, when in water or blood, they move wherever they are carried. It does not matter whether a germ can move by itself or not as regards its power to do harm. There are

* Cocci when strung together in chains are called Streptococci.

† These are the plural forms of these Latin words. The singulars are: bacterium, bacillus, spirillum.

‡ There are other forms which we need not trouble about further, such as moulds, yeasts, actinomyces, etc.

germs which can move and others which cannot ; but some of both these kinds are harmful.

Germs grow very quickly. When a germ finds itself surrounded by food it eats freely and then divides into two. These two halves now form two separate germs. These germs also eat freely and then each one divides into two, and so on. This goes on at such an enormous rate that from a single germ many crores of germs result often in a few hours, if there is enough food for them and unless they are interfered with.

How can they be interfered with and prevented from growing at this enormous rate ?

By freezing them we can stop their growth. That is why we freeze meat and milk in order to keep it. Freezing stops the growth of the germs which make meat or milk go bad. When a germ falls from the air into bowl of milk it finds itself surrounded by an enormous quantity of food some of which it at once proceeds to eat. When well fed, it then starts to split into two and so on and in a few hours the milk swarms with germs. But if the germ falls into frozen milk it finds itself so uncomfortable that it cannot even eat the milk particles round about it. *It is not killed but it cannot grow.*

Drying kills most germs quickly ; and the sun's action also kills them more or less rapidly.

Take another case. Suppose we are boiling some milk and a germ which has got stuck to a particle of dust falls into the milk. The boiling kills it in a few minutes. Dead germs cannot divide, and come to life again and they can do no harm to the milk or to any one who drinks freshly boiled milk. If the germ that fell into the milk had happened to be a cholera germ and if the milk had not been boiled but had been drunk by a man who was in the condition in which he could take this disease, what would be the result?

The cholera germ would have been able to grow. Enormous numbers of these cholera germs would swarm in the milk. And these germs would in most cases, go on living and increasing in numbers in the man's bowels and would poison him. How ? By pouring out poisons from their bodies. We pour out poisonous substances from our bodies which we saw are called our excretions. So also do germs. These poisons poured out, for instance, by cholera germs are absorbed from the intestines (or stomach in some cases) and poison the man as surely as if he had been poisoned with arsenic. The poisons produce certain symptoms in the man and when we see a man with these symptoms we say "he has got cholera."

The poisons which germs pour out are called *toxins*. The body tries to defend itself from these by producing *antidotes*. (Latin, *anti*—against). These are called *antitoxins*. If the person who has been poisoned by a certain disease-germ and has got the disease, is not killed, it is because the antitoxins of his body have rendered the toxins harmless and the germs have been destroyed by the body ; or because he got too small a dose of germs and therefore was able to defend himself by killing the germs and rendering their secretions harmless by means of the antitoxins of his body.

After such a disease the person generally cannot get the same disease for some time after—in some cases, never again. He has been made safe from that germ. This state of being safe is called *Immunity* and the person is called *immune*. Now we have seen that we can kill the germ by means of heat or by poisoning the germs by means of chemical substances. If we take some germs and boil them for some time we cannot now grow them.

Some germs require more boiling than others. There is one kind which is particularly difficult to kill by boiling only once. These germs are those which do not multiply

themselves by simply splitting in two. Instead of that they increase in numbers somewhat in the way higher animals do. They form what are called *spores* inside their bodies. Each spore is a round or oval body which can be seen by the microscope lying inside the germ's body. The germ's body bursts open and the spores get free. The spore then grows rapidly into a germ. Now when germs multiply by means of spores we must boil *at least twice* in order to kill them and their spores. The *first* boiling kills the germ which softens and splits open and sets free the spore. The *second* boiling kills the spore. There should be a little time between the first and second boiling so that all the germs may have time to soften, burst and set free the spores. Moist heat (such as steam) at the boiling point of water (100° Centigrade or 212° Fahrenheit) or even at a greater heat than this is best. Dry heat—that is, where not much or any water-vapour is present—is not nearly so good as moist heat. Why? Because the moisture helps to soften the germs and set free the spores. Also because the very hot particles of water in the steam come into close contact with the germs and kill them. Heated steam carries more heat than heated air or indeed anything else. Also because steam penetrates better than dry air into clothing and into other things in which we wish to kill germs. This destruction of germs by heat or by chemical poisons is called *Disinfection* and we will see later how this is best carried out practically.

Germs can be grown on certain food-stuffs and studied in this way by scientific men. In preparing such food-stuff we first kill all the germs and their spores in it by boiling several times. It is now free from germs and is now cooled and is ready for our experiment. We place the germ we wish to grow on the food-stuff (called a culture-medium), and we take certain precautions to prevent other germs falling on this culture-medium while we are growing on it

the germ we are examining. This we do by killing by heat or chemicals all possible germs on the plates and glass covering-dishes we are using. Then we have the germ we are examining free from all others and placed in the midst of plenty of food (in the culture medium). We find it divides or pours out spores and very quickly thousands—even crores and millions of germs are formed. These we can study in many different ways, and this study is called *Bacteriology*.

Contagion. Diseases that can be given by people having those diseases to others are said to be got by contagion. Such diseases are often termed contagious diseases. The term *infectious* or *communicable* is better. All *infectious diseases can be prevented if we only take enough trouble to do so.*

Infective diseases can be spread :

1. Through the air, for example, small-pox, pneumonic plague, diptheria, consumption (tuberculosis) from the sick person's breath or body.

2. By food or drink : as cholera and enteric fever by means of dust, flies, excretions from the sick and by soiled hands.

3. By clothing, furniture, letters, &c., as small-pox.

4. From the soil, for example, tetanus.

5. By contact with the diseased person (example, small-pox) or by some one who has been in contact with the diseased person (example, small-pox).*

6. By certain insects—mosquitoes (malaria, yellow

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* "Diseases such as leprosy, fever, consumption, opthalmia, etc., pass from one man to another by means of contact of the body, from the breath, by eating together, by lying together, by clothes, garlands, or substances which are smeared over the body."

(*Madhab Nidana*).

"Let him not use shoes, garments, a sacred string, ornaments, a garland, or a water vessel which have been used by others."

(*Laws of Manu*).

fever) ; tse-tse flies (trypanosomiasis) ; ticks (African spirillosis) ; fleas of rat (plague) ; &c.

Diseased animals may also infect man in certain cases,—for example, anthrax or "wool-sorters' disease" which is got from sheep's wool ; Glanders which is got from horses suffering from the disease ; Hydrophobia from rabid animals ; and plague (indirectly by fleas) from rats.

That is to say, that anything or any body that has become contaminated by touching or coming near a diseased person may cause the diseases under certain conditions. Why ? Because the living germs of the disease are carried by these things or persons to other healthy persons. The germs find a place to grow and increase in number in the healthy persons' bodies and cause the disease. The germ of cholera can only cause cholera. It cannot, for instance, cause enteric fever or Plague which are diseases only caused by their own special germs. Therefore a germ which only causes one particular disease is called a *specific* germ or the special germ for that particular disease.

When the germ of a disease gets into a human body it goes on growing and increasing in numbers and thus causes the disease. But, fortunately for us, every disease germ we receive into our bodies does not necessarily cause its disease. For a germ may get into a part of the body where it cannot grow. So it dies and is cast out of the body without having done any harm.

But in people in bad health or who are living in crowded unhealthy houses, or who are starved this is less likely to occur, as a rule. And, again, it is true that though the body may be in perfect health yet if germs of a particular disease get into it they grow and cause disease and perhaps kill.

Certain germs, say of cholera or small-pox, cause worse and more dangerous attacks of these diseases than other cholera or small-pox germs. In some outbreaks of cholera

almost every person who gets the disease dies. In other outbreaks of cholera very few people die. The reason is that the cholera germ is not always equally poisonous. It is able to cause death in every case at one outbreak ("black cholera") and in other it gives a very mild form of the disease.

In India, the chief cause of disease may broadly be said to be one or other of the following :—

1. Infection by germs or insects or other parasites.
2. Over-exposure to the sun's rays.
3. Excessive exercise.
4. Chill.
5. Excessive eating or drinking or from eating unsuitable food.

The first and last groups account for most of our ailments. Germ-infections and excesses especially in eating are the most frequent causes of disease.

Immunity from disease.

Some people escape disease much more than others. Again there are people who seem to get a disease as soon as they are exposed to it. A person, who has the power of resisting a disease and not getting it however often he has the chance, is called *naturally immune* or safe from that disease. His blood has apparently a great power of destroying any germs or their poisons which find their way into it. It is the same with other poisons. Some people are unable to take certain kinds of food as they act in a very violent way on them though with most people they have no such violent action.

There is another kind of Immunity and that is called *acquired*. Certain people who have taken arsenic or opium from their childhood at last are able to take it in doses that

would quickly kill any one else. So it is with disease. We can get immune or safe from a disease through having been attacked with it. For instance, people who have had small-pox once are never attacked by it again as a rule. We can also prevent small-pox by means of Vaccination which is a similar process in many ways. But the difference is that Vaccination, if carefully done, is quite safe. Small-pox is so deadly a disease that we should all try to save ourselves from it by being vaccinated.

Epidemics. When a disease attacks large numbers of persons at one and the same time it is called an epidemic of the disease. It does so by being spread rapidly from one person to another. Suppose a man with small-pox goes into a very crowded house. He poisons the air and everything he touches and by these means he poisons the rest of the people in the house. They take the disease and it goes on growing in their bodies for about twelve days. Then they are attacked with the disease's symptoms—fever, back-ache, skin-eruption, etc. If these people go about the town in which they are living they will poison many others through the air and through any things they touch. So that in a very short time there may occur hundreds or even thousands of cases from a single case. This is called an Epidemic of Small-pox.

Endemic diseases are diseases which do not break out suddenly like Epidemic diseases. They are *always more or less* present in a particular place. They are caused by certain *local conditions*. A good example of such a disease is typhus fever. This used to occur in jails all over the world so often that it used to be called jail fever. It was helped to occur by the starvation and filth of the prisoners and carried by the bugs which infested the jails. In many towns the jail was the only place where typhus fever cases occurred. This, then, was an endemic disease.

Cholera is endemic in Lower Bengal and spreads from there in epidemics. Lower Bengal has a soil full of organic matter and has a hot, moist climate also, both of which favour cholera. Here cholera is never absent all the year round.

Sporadic diseases are *scattered* diseases, and not epidemic, though they may become so. For instance, if 1 or 2 cases of cholera occur in a town but do not tend to spread such cases are called sporadic. But such sporadic cases may cause an epidemic unless care is taken to prevent their spread to other people.

Infectious diseases spread most rapidly in unhealthy, overcrowded, dirty houses or towns where the water-supply is bad. It is not necessary for all these conditions to be present—one of them may be sufficient in certain cases. *How are we to prevent their spread ?*

1. The sick person must be kept apart from others. If this is not done he will directly spread the diseases to them.

2. All discharges from the sick person that may carry the disease to others must be rendered harmless. This is best done by means of fire or by using certain chemicals called disinfectants.

3. The room and house, bed and other furniture, phulkaris, carpets, dharris, cups, plates, the clothing and especially the bedding must be made pure and clean by means that will presently be described.

4. All persons who have nursed or been in contact with the infectious case must take certain precautions (to be later mentioned) so as not to spread the disease. Therefore, visitors should not be allowed to see any one suffering from an infectious disease.

5. The sick man must not be allowed to mix with other people till he is unable to give the disease to them.

Cholera is caused by swallowing the germ which causes Cholera. The germ is generally swallowed in water or in

milk or as dust or with infected food. The germ dies on reaching the stomach if it contains food. For the germ dies in presence of acids and the gastric juice is acid. When the stomach is empty (or if contains *only* water) it contains no acid. Hence the germ can pass through the stomach into the intestines where it can grow. Therefore cholera is likely to attack starved people, or even people who go about without food in the stomach when cholera is about. People who are tired bodily or who are anxious or depressed in mind are also very likely to get cholera as they cannot then resist the germ so well. When the germ has been swallowed and if it is not destroyed in the body it increases enormously in numbers and poisons the person. It will cause the disease to appear in a few hours or perhaps not for two or three days but generally in from three to six days. Then the patient is attacked with violent vomiting and purging of stools which look like water in which rice has been cooked. Violent cramps are felt in the belly and legs. The person becomes pinched in appearance, cold all over, and the pulse can hardly be felt. Death usually (about 1 out of every 2 cases) soon follows in most severe epidemics of the disease. Unless precautions are taken the disease will rapidly spread to others.

Prevention of Cholera. Cholera is a filth disease. It is spread from man to man, for example, by travellers from one place to another so that pilgrimages have carried the disease all over a country. Water is one of the chief ways by which the disease gets into the body. If water containing cholera germs is drunk (when the stomach is empty especially) cholera is almost certain to follow. Therefore, keep all water intended for drinking purposes boiling for at least five minutes. Then cover it and let it cool.

Boiled water should in cholera times alone be used for washing the face and mouth and hands. Do not use filter

water in cholera times. Trust to boiling alone but see that the vessels in which the water is kept are well cleaned out every day *with boiling water.* If a filter is used it may not be clean and it even may contain cholera germs. So that filtering water through such a filter would be worse than ever. Boiling for 5 minutes will completely kill the cholera germs. Again all milk should be kept boiling for 5 minutes before being taken during cholera times. If the milk has been mixed with water containing cholera germs or if the milkman's hands be fouled with dust or other matter containing cholera germs or if the *lotah* be washed with infected water even then the milk will be rendered safe by *being kept at the boiling point for five minutes.*

Again soda-water, lemonade and other aerated waters and ice may cause it if made from cholera-infected water. These should, therefore, be avoided in cholera times. Fluids can be quite well cooled by surrounding the vessels containing them with ice (as in an ice-chest) or swinging them in a basket covered with wet grass.

People suffering from severe indigestion are liable to have the contents of the stomach made alkaline (from excess of mucus) and thus they lose the natural protection of the acid gastric juice. To prevent indigestion in cholera times is therefore specially necessary. Hence, the meals should be as simple as possible. They should be taken at regular intervals—not longer than four hours between each meal.* Avoid tinned foods; and especially rotten, over-ripe or unripe fruits or stale vegetables. Be very careful as to all vegetables and fruits eaten uncooked and especially of those grown on manured soil (melons, cucumbers, lettuce, watercress, etc.). In fact, it is safer not to eat fruit at all

* It will be observed that this is oftener than is advised under *ordinary* circumstances. Every five hours is the best rule for *ordinary* use.

during cholera times. Avoid sweetmeats which are specially likely to cause indigestion.

Butter should be made from boiled milk and not bought in the bazar, for water is often added to it to adulterate it and this water may be infected with cholera.

Cheese and nuts should be avoided. Do not eat cold boiled rice or dal which has stood overnight. Cover all food so that flies do not get at it, for flies often carry cholera by feeding on infected matter and then flying on to food and transferring the germ of cholera to it.

All cooking vessels should be thoroughly well washed out with boiling water after use and kept very clean. Be specially careful that all food-dishes are clean. Not only should they be washed in recently boiled water but servants handling them should wash their hands well with soap before each meal.

The house—especially kitchen and pantry—must be kept very clean in cholera times above all others. Decaying vegetable or animal matter must on no account be allowed to lie about in or near the house. Keep the floors as *dry* as possible. Carpets and dharris should be well shaken. Keep the house well ventilated but avoid draughts.

All house-latrines should be kept as clean as possible and should be well sprinkled twice a day with a disinfectant such as Phenyl and water; carbolic acid 1 part in 20 parts of water; or with Corrosive Sublimate 1 part in 1000 parts of water.

Do not wear damp clothes. Have your bed clothes aired every day well—in the sun, if possible.

Try as far as possible to avoid getting over-tired in any way. People who are over-worked and worried take the disease much more easily. But do not allow yourself to be depressed by fear of an attack. If you will only take sufficient care you can guard yourself against attack.

If one takes strong purgatives or is suffering from diarrhœa, the stomach's contents (along with any cholera germs that may have been swallowed) are apt to be hurried on into the intestine. Hence the acid gastric juice has not time enough to kill the cholera germs. On this account, never take strong purgatives during cholera times.

And if attacked by diarrhœa during cholera times, take a dose of opium at once so as to stop the diarrhœa. Laudanum (tincture of opium) may be given in this way—give one drop for every year of the patient's age up to thirty. Do not give more than 30 drops to a grown up person and do not repeat that dose for at least 3 or 4 hours in most cases. People nursing cholera patients should be most careful to wash their hands in weak carbolic solution (1 part carbolic acid in 40 of water) before eating or drinking or else they may get the disease.

Remember that the germ is carried by the vomit and bowel discharges. Therefore these must be rendered harmless. The vomit and motions should be mixed with Corrosive Sublimate solution and allowed to stand for an hour. They should then be buried deep in the earth far away from any well or source of water supply. Or, better still, mix with sawdust and burn *as promptly as possible.*

Be most careful to disinfect (see Chapter 7) all bedding, clothing, food-utensils or other articles touched by the cholera patient. The hands of anyone who has had to touch the patient must be *thoroughly* washed with carbolic soap and the finger-nails kept very short so that infected matter may not lodge under them. Never eat in the sick-room and be sure *always* to wash your hands before eating.

Cholera patients should be kept away from all other people till recovery is complete.

Get rid of flies as much as possible as they frequently carry the infection in cholera times. Keep flies away from

the patient or his soiled linen, stools, urine or anything used by him. (Refer to the special notes given in Chapter VIII as to the best way to rid of flies.)

It has lately been shown in India that persons who have had cholera can act, for months afterwards, as spreaders of the disease. The germs are stored up in the gall-bladder in such people. They pass out with the stools and may cause cholera in the usual way. Persons who seem quite well and yet go about spreading cholera or enteric fever or dysentery in this way are known as "carries." The means of dealing with carries is a most difficult question. All we can do meanwhile is to protect ourselves by taking care to prevent the disease as above described.

Small-pox is one of the most infectious and fatal of diseases which attack the human race. Dark-skinned races (especially negroes) are especially likely to suffer from it. *The poison of the disease is present in the small pocks* (hence the name). The pock is the skin eruption (or rash) which occurs in small-pox. It is so called from the Latin word for a little cup (pocula) for the rash later becomes cup-shaped.

The poison of small-pox enters the body by being breathed in or swallowed. It may also get into the body by a wound or scratch of the skin.

The poison then increases enormously in the blood and causes the fever, eruption and other symptoms of the disease. The poison is discharged or cast off from the body chiefly by the matter (pus) and dried scabs from the skin-eruption. So the danger of coming near a person with small-pox is evident as small-pox is nearly always got by means of infected air. Also coming in contact with bedding, clothing, cups, plates, etc., touched by such a patient is most likely to cause infection. Children suffer most. "Children are the food of Sitala" (the small-pox goddess) is an Indian proverb. The

reason of this is merely that they take the disease as soon as they meet it and are infected, whereas most adults have already had it or have been vaccinated.

An attack of small-pox has several stages :

1. **Incubation**. Generally it is 12 days after infection before the disease begins to show itself by symptoms. But one may get it nine days after infection or not till 15 days after, though 12 *days is the usual time.*

2. **Invasion Stage**. The first symptoms are a feeling of uneasiness, headache, severe pain in the back and legs, shivering, feeling of cold even in the sun or near a fire, sickness and vomiting, and fever which may be high.

3. **Eruptive Stage**. The rash shows itself on the third day after these symptoms begin. It is first seen on the brow and chest, then on the face, neck, body and lastly on arms and legs. The mouth, nose, throat and eyes are attacked and blindness and deafness often follow. The rash consists of a lot of *hard* little lumps sticking up from the skin. They may be seen later to have a little fluid at the top. In about 4 days or so these lumps become *cup-shaped* at their tops. With the appearance of the rash the fever becomes less.

4. **Ripe Stage**. The pocks now "ripen" and become surrounded by a red ring. Pus or matter is now present in them. The fever increases again at this stage.

5. **Drying up Stage**. The pocks now get covered by a scab formed by the dry pus. This is the most dangerous time for other people, as the scab falls off and poisons the air. It may be carried by dust or wind, and be breathed in or swallowed by other people thus causing infection. As in cholera, many outbreaks of small-pox may be so severe that most of the people attacked die ; or it may be very mild and then few or none may die. *But a very mild case may cause a fatal or extremely severe attack in other people infected by it.*

How long can a small-pox patient cause the disease in others? Until all scabs and flakes of dead skin have fallen off. After this six baths should be given at intervals of two days between each bath.

Chicken-pox is a very common disease among children of from 3 to 10 years of age and often attacks grown-up people in India. It might readily be mistaken for small-pox. It is also very infectious, but death from it is exceedingly rare. But in it the rash appears *in a few hours* after the symptoms begin to appear. Its *incubation* period is generally about the same as that of small-pox but it may occur from 4 to 16 days after infection. A doctor will generally be able easily to distinguish between the rash of chicken-pox and that of small-pox.

Prevention of small-pox. Any one suffering from the disease must be placed apart from others and kept so until he can no longer give the disease to others.

The skin of the whole body must be wiped over with vaseline or olive oil so as to prevent any part of the scabs from passing into the air and infecting other people. The patient should spit into a *gumlah* containing carbolic solution (1 part of carbolic acid to 20 of water). Rags used for wiping the nose, etc., should be at once burnt.

The bedding and clothing should be burnt and the furniture should be twice thoroughly well washed over with 1 to 20 Carbolic Solution. The rooms in which the patient has been living should be disinfected well (see Disinfection). But the great means of preventing Small-pox is by

Vaccination. So when small-pox is about all people who have not been vaccinated since they were young should be vaccinated at once. All children should be vaccinated shortly after birth and again when between 10 and 12 years of age, for children are particularly liable to get the disease.

Vaccination is one of the greatest discoveries ever made and it is to an English Doctor, named Jenner, that the world

owes this great boon. In India and China from very early times people have tried to prevent the ravages of small-pox. It was found that when some of the poison from a pock was put under the skin of a healthy person a much less fatal form of small-pox was the result than if the disease had been got in the usual way. Now small-pox very rarely attacks any one twice. So on these facts inoculation was founded. The disease is so infectious that the chance of escaping it was found to be very slight. So people wished to get it in as mild a form as possible and be safe from it afterwards. In the disease got in the ordinary way 1 person died out of every 5 attacked. But by inoculation only 1 person died out of every 50 who were inoculated. This was an advance but then this plan had one disadvantage which utterly condemns it. *It spread the disease in epidemic form*, and thus it ended by doing more harm than good. Inoculation is still largely used by ignorant people in India.

But thanks to Jenner and Vaccination, people need no longer fear small-pox.

Jenner observed that people who had to milk cows and who got a disease from the cow called cow-pox did not get small-pox. In other words, cows get, so to speak, a *modified* or mild form of small-pox (called cow-pox) and this disease (which is not at all dangerous to human beings) protects the person who has had it from small-pox. Jenner took some of the fluid from the pocks of a cow suffering from cow-pox and inoculated human beings with it. He found that a pock formed at the part inoculated and the person's body (by means of what had been absorbed into it) could now resist the small-pox poison. This protective disease (cow-pox) is a very slight one and not at all dangerous if the vaccination* has been carefully done. *Cow-pox* is not infectious. It

* Vaccination is so called from the Latin word *vacca*, a cow.

can only be got by inoculation. If a child is vaccinated shortly after birth, and again when about twelve years of age, its chances of ever getting small-pox will be very small. But as people can in very rare cases get a second attack of small-pox so vaccination in rare cases may not protect from small-pox.

The following facts as regards vaccination must be borne in mind :—

1. Vaccination very considerably lessens the chance of taking small-pox.

2. Vaccinated persons who get small-pox have it in a much milder form and are much less liable to die from it.

3. Vaccination may protect from small-pox throughout life but generally it protects :—

(*a*) most for 10 years after it has been done ; (*b*) for the next 5 years less so ; and (*c*) much less later.

4. A second vaccination protects the person very much more. *A child should be vaccinated within 4 months of its birth and again when 12 years old.*

5. The more thoroughly the vaccination is done the greater is the amount of the protection against small-pox.

6. Revaccination during small-pox epidemics should be done so as to make as certain as possible of not getting the disease.

7. If there is a small-pox epidemic even newly born children should be at once vaccinated.

8. If small-pox occurs in a household every person in that house should be at once vaccinated.

9. People who have been in contact with small-pox cases and who begin to show symptoms which may be due to the disease should be *at once vaccinated.* In this way the disease may often be prevented from attacking the person. In any case it will make the attack much milder.

10. *Persons nursing small-pox* patients ought to be thoroughly revaccinated.

In vaccination two kinds of the protective fluid (*vaccine-lymph*) may be used : (*a*) calf lymph (which should always be preferred) ; and (*b*) lymph drawn from the vaccination pocks on human beings.

Where it can be done the best and safest way of all is to vaccinate *straight from the calf.* A calf is inoculated with vaccine lymph on its belly (a portion of which has to be shaved of all hair and cleaned well with soap and water). About six or seven days later the calf is ready to be vaccinated from.*

Some of the fluids is drawn off from the pock and received on a small knife or lancet which has been thoroughly cleaned by holding its blade in a spirit-lamp's flame for a few minutes. With the point of the knife the arm is scratched slightly—not enough to draw blood—and then the flat blade is well rubbed on the scratches. *Four* scratched patches—*never less*—should be made on the arm or leg. Each patch should be at least an inch away from other patches. Vaccination can be done at any season of the year. The old idea that vaccination could not be performed in the hot weather in India is incorrect. Calf lymph mixed with lanoline, vaseline, or glycerine to keep it fresh is now much used.

Course of vaccination. In about 3 days a pimple or pock forms. Several small points may be seen and in these there is a little watery fluid under the skin (vesicles). After 6 or 8 days as a rule a little pus or matter forms and a red ring surrounds the pock. Then a scab or crust forms and the whole pock now dries up. About 20 days after vaccination the scab falls off. There is now left a reddish cupped scar

* The calf is not in any way harmed by the inoculation.

which at last becomes quite white and forms *the vaccination mark.* This usually will never disappear and when distinct it is a sign of successful vaccination.

It is not uncommon to hear people (who are ignorant of the facts of the case) say that vaccination does not protect against small-pox. This is not so.

Thorough vaccination has been completely proved to protect man against small-pox. Where vaccination does not protect it has been as a rule badly and carelessly performed. Even if it were true (which it is not) that vaccination does not protect against small-pox it would still be most necessary to be vaccinated, for vaccinated people—if ever attacked by small-pox—take the disease so much more mildly. If people are vaccinated thoroughly at birth and again when 12 years old and also when any bad epidemic of small-pox is raging, they will have very little cause to fear small-pox.

In the vast army of Germany in which every one has been vaccinated and revaccinated only two deaths from small-pox occurred within 25 years. In Prusia revaccination is compulsory. Since 1885 not one person in 100,000 has died of small-pox; and since 1894 *not one in a million.* No evidence could be stronger than this in favour of vaccination and revaccination. That this is generally recognised outside the medical profession (except by faddists, fanatics, and the ignorant) is shown by the fact that many Insurance offices now refuse to insure a person unless vaccinated.

It has further been said that certain diseases may be given by vaccination. This is impossible if the lancet is properly cleaned and if good calf lymph is used.

To show the result of vaccination, take the case of a town in England, called Sheffield, where there was a great epidemic of small-pox some years ago. Of *vaccinated* children under 10 years of age, only five in every 1000 were attacked

and only 0.09 in every 1000 died. Of *unvaccinated children*, 101 in every 1000 were attacked and 44 in every 1000 died.

So nearly 20 times more unvaccinated children took the disease and nearly 44 times as many died than of vaccinated children.

Plague. This disease is due to a bacillus which can only live in the bodies of insects or animals, being unable to exist outside of such. The chief types of the disease are :—

(1) Bubonic Plague, where the lymphatic glands (especially in the groin and arm-pit) swell into lumps called buboes. This form is entirely spread by bites from the fleas of rats ; and is not infectious in itself.

(2) Pneumonic Plague is the less common form where the lungs are attacked by inflammation (Pneumonia). This form is spread from man to man by the breath, spit and other means of infection.

(3) Septicæmic Plague is the least common form and in it the symptoms are those of acute blood-poisoning.

In Bubonic Plague the disease is spread from rat to rat and from rat to man, and only by means of the rat flea, (as has been most clearly proved by experiments).

It used to be thought that insanitary conditions caused plague but they only do so by helping to harbour rats.

It is in this way that the disease is spread, for people carry the rat fleas on their persons or in their baggage and the fleas bite other people and so spread plague. The persons carrying the fleas may escape plague through being immune in some way.

An attack of plague is brought about thus : First, the rats in a house get plague. Some of them die and other rats in the house run off elsewhere leaving their nests infested

with fleas. These fleas contain plague bacilli through having sucked the blood of rats suffering from Plague. The fleas then bite the people in the house who get plague thereafter.

In order to get rid of plague or prevent it attacking the household, rats must be got rid of and given no chance to breed or live in any part of the house or buildings near it.

They must be deprived of food so that this means keeping grain and other food from them. Store the grain in pucca rooms with no holes anywhere in the walls or roof by which rats can get in. And the doors and windows must be closed in by wire-netting just as described for keeping out mosquitoes. The openings of drains must be covered with iron gratings close enough to keep rats out. Again all rubbish heaps and collections of refuse must be entirely got rid of, for rats find plenty to eat in such. Absolute cleanliness in this direction is one of the first duties.

The rat's shelters in the house must be got rid of. Thatched or tiled roofs harbour them. Do not have domestic animals such as cattle, hens, goats, &c., in or near the house. Store as little as possible in the house for such stores are the rat's chance. The custom in some European houses in India of keeping horses' grain in the verandah (so as to prevent thefts by the Saises) should be abandoned. For it obviously tends to attract rats. Rats must be destroyed without pity. Dead rats must be burnt entirely. Take care that servants' houses in your compound do not harbour rats which may infect your house in turn.

Europeans escape plague more than Indians because their houses are kept cleaner and are usually built so as to give rats small chances of living there without being noticed and cleared out.

Gunny bags and grain sent to a distance as well as clothes may spread the disease when fleas are in these articles. Captain Cunningham, I.M.S., has recently proved that such

articles are easily rendered safe by sufficient exposure to the direct rays of the sun. He recommends :—

(*a*) That a flat piece of ground be covered three inches deep with fine sand only (no stones or grass).

(*b*) The clothes should be spread in a single layer and left in the sunshine for at least one hour. (Razais and padded clothing must be turned over once or twice during this exposure).

(*c*) No clothes must be placed within a yard of the edge of the sand.

(*d*) The sanded area must be fenced in to keep animals from straying over it.

(*e*) The area must be chosen so as to get the full force of the sun all day so as to ensure killing all fleas by sunlight.

Plague cases, and those persons who have come in contact with such, should be carefully kept apart until risk of spreading infection is over.

Buildings in which plague has occurred must be emptied entirely. The roofs of huts should be taken off so as to let sun and air in. The rooms must be thoroughly treated with substances such as "Pesterine"* (crude petroleum) to destroy any rat fleas left in them. It is brushed on floors and walls to a height of about 3 feet. Pesterine may also be mixed with equal parts of Kerosine oil and applied by an ordinary garden spray. All articles which may have been infected by plague cases must be thoroughly disinfected. Discharges, fœces, &c., of plague cases should be burnt, if possible. *Those who have to disinfect houses or who may come in contact with plague cases should most certainly be protected by inoculation by Haffkine's method.* Free

* Kerosine oil emulsion (1 in 1000 of water) may be used instead. It consists of kerosine oil 82 parts, common soap 3 parts, water 15 parts.

ventilation of all premises must not be over-looked. *But inoculation by Haffkin's method is as yet our best means of protection against plague.* This method does not absolutely prevent plague but it enormously lessens the chance of attack. And if an inoculated person does get plague, he is much more likely to recover than is an uninoculated person.

Plague epidemics occur in certain places at certain seasons every year. This depends on the time of year which favours the multiplication of fleas. The further one goes from the Equator the later in the year is the epidemic. Thus in Bombay, March ; Lahore, April ; Jhelum, May ; Rawalpindi, June ; and further north than that, July to September. Epidemics decline when the average daily temperature goes above 85° Fhr. which means dry weather in India, for fleas quickly die at this temperature if the air is dry. If the air is very moist they may be able to live in spite of the heat. Recent investigation in India shows that where plague has attacked a village at the beginning of the plague season it generally exhausts itself. Next plague season such a village is not likely to start a fresh epidemic. But if the village has been attacked late in the plague season the disease is most likely to cause a fresh epidemic next year. Hence special care must be taken to see that no precaution is omitted to prevent a fresh epidemic in such villages as are infected late in the plague season.

Malarial Fevers. These are caused by a microscopic parasite (Plasmodium, see diagram at the beginning of this Chapter) which gets into our bodies by means of the bites of certain mosquitoes. The kind of mosquito in which the malarial parasites live is called *Anopheles* which can be recognised by its spotted wings from which it is known as the "dapple winged" mosquito. Many mosquitoes belong to a species called *Culex* (or grey type) and they cannot

convey the malarial parasite. Certain of the Anopheles species are found round about houses in dark places as well as in swamps, woods, &c. It is the female mosquitoes that bite man. They lay their eggs in any water *which is not moving very rapidly*. These form the *larvæ*. These larvæ can be quite easily seen with the eye. They are dark brown and like very small thin worms. They are about ¼ inch long usually. The larvæ of Anopheles *float flat on the water*. (The larvæ of the Culex hang *head downwards* and thus can be distinguished from Anopheles larvæ readily.) The Anopheles mosquito, when resting on a wall is obliquely inclined to it. The Culex mosquito's body is parallel to the surface of the wall. Mosquitoes, for our purposes here, may be classified roughly as :—

1. *Domestic :* (*a*) Culex or the grey type which conveys dengue and filariasis ; (*b*) Stegomyia or speckled or "tiger" mosquito—a black and white striped kind—which conveys yellow fever.

2. *Marsh* mosquitoes to which class belongs Anopheles or the dapple-winged kind which conveys Malaria.

Mosquitoes specially like to lay their eggs *in rice fields*, water-barrels, in clear, slowly flowing water, in pools of water, in pools in jungles full of weeds, and in flower pots, under trees, in soil where the ground water is near the surface, in tanks and in cracks in bath-room or bottle-khana floors. If the water is salt or contains sulphur they do not lay there. They also like dark almiras, hanging clothes, curtains, wells, etc., for the day time. They are blown away by strong winds. They are paralysed for the time by cold weather. They cannot fly very far above the surface of the ground, so that people living on hill-tops or even in very tall houses suffer less from them. In Indian hill-stations well over 6000 feet high they are very much scarcer

than at lower levels. But malaria-carrying mosquitoes most certainly may occur in hill-stations.

It used to be believed that malaria did not "rise" higher than 3000 feet above sea-level in India. Mosquitoes do not fly far from their birth place, and cannot thrive in cold air and, again, natural drainage is better in hilly country so we can understand why it is supposed that malaria ceases at a certain height above sea-level. Malaria-carrying mosquitoes fly by night and fly near the ground : hence the danger of being out at night in malarial districts.

The Anopheles mosquito, then, bites a person suffering from malarial fever, and sucks up some of his blood containing malarial parasites. These parasites after undergoing certain changes in the mosquito's body are again injected into the body of any one bitten by that mosquito. They increase in large numbers (and especially live in and feed on the red blood cells) and cause malarial fever.

Quinine cures malarial fever. It does so by driving the malarial parasites which cause the fever out of the blood. An ordinary attack of malarial fever has a hot, a cold and a sweating stage. When the attack is over the patient may be quite free for a day or two and may then be attacked again as before. This may go on regularly for a long time. The result is that the patient becomes very pale and bloodless, his liver and spleen get much larger, and he is weak and often unable to resist other diseases to which he is exposed, for example dysentery. He is also unable to work for any length of time. Malarial fevers are commoner, more severe and more dangerous in children.

A few people never get malaria (are "immune" to it) but most people in a malarious district suffer from it. A slight amount of protection is got from a previous attack.

It will thus be seen that the mosquito appears to be the

chief means of spreading malaria. That it is the *only* means is still denied by some.

Mosquitoes of the Culex variety carry not only the fever called dengue but also convey the parasite called filaria, sanguinis homonis (chiefly carried by *Culex fatigans*, a domestic mosquito) which causes filariasis which results in elephantiasis and "milky urine" (chyluria). The necessity for destroying the Culex in its breeding places and haunts is therefore very clear.

The Stegomyia mosquito has been proved to be the chief means of spreading Yellow Fever—a most fatal disease which is specially met with in South America and the West Indies, but which has not as yet occurred in India. As the Stegomyia mosquito is one of the types of house mosquito its extermination is very desirable. For Yellow Fever may be brought to India through the newly opened Panama Canal. If the germ of yellow fever gets to India, it will find the Stegomyia mosquito there and this may result in producing Yellow Fever throughout India. The importance of killing Stegomyia mosquitoes and preventing their breeding is thus obvious.

Prevention of Malaria. Of all measures for this purpose, there is none so hopeful and easy to carry out as the taking of quinine occasionally, as described a few paragraphs further on.

Other means are to have no stagnant water near dwellings.

Drain all pools, marshes and other breeding places. Use subsoil drainage when the ground water's level is high. Plant trees (Eucalyptus especially) which act by drying the soil. The trees should not be too near houses for mosquitoes live in such shady places.

Remove all old empty *ghurrahs*, broken flower pots or bottles, kerosine tins, loose bricks and tiles, etc., from the

neighbourhood of the dwelling. If not, mosquitoes will certainly breed in or about them.

Do not keep water stored in large vessels (*ghurrahs*) or tubs in a bath-room as mosquitoes will breed there. Catch pits for bath room water must be disused. The kitchens and servants' quarters must be given close attention in all such respects.

People suffering from malarial fever should be kept as much as possible away from others for mosquitoes will bite them and then spread malaria by biting others.

Barrels for holding rain water should be specially watched. A small quantity of kerosine oil should be put into them once a week so as to form a layer on the surface of the water. This layer prevents the mosquito getting enough air and prevents it from breeding. Tanks should be treated similarly—one ounce of crude kerosine oil being used for every 15 *square* feet of the tank's surface. Fish in tanks are most useful as they eat the mosquito's eggs. Clear out all plants from tanks and all jungle from their banks (to prevent the mosquito's larvæ seeking refuge), as far as possible.

Fill up all hollows in the ground near your house to prevent pools of water forming. Keep houses as clean as possible. The rooms should have plenty of light and air always.

Bats, lizards and spiders prey on adult mosquitoes.

Clear away all decaying vegetable matter from round about the house.

Shake, every day, curtains and clothes which have been hung up ; and at least once a week place in the sun.

In the case of towns or villages or isolated houses "mosquito brigades" should be formed. That is, a number of coolies ought to be trained to remove all the above mentioned dangers from mosquitoes. They must be well supervised. Municipalities, planters, Government and

private individuals ought to help and subscribe for this purpose.

Burn Keating's powder or Sulphur in the rooms when empty so as to drive the mosquitoes out. Or mix three parts of powdered pyrethrum with one part of saltpetre ; spread a layer ½ inch deep on an iron plate. Then light at several points. 8 ounces is needed for every 1000 cubic feet of air space. Close up the room tightly while fumigating by any of the above means.

The early morning air and night air should be avoided.* (These times are when mosquitoes are active and flying about). Sleep under mosquito-curtains and look every day to see that there are no holes in them. Place the bed with mosquito-net in a current of air so that there may be enough fresh air inside the net.

The bed must be broad enough to prevent any part of the body touching the mosquito-net.

The ends of the mosquito-net must be well-tucked below the mattress and must not hang down to the ground.

The net should be gathered up during the day time after rising but should always be let down in the afternoon and tucked well in.

If poles are not available, place two hooks in one wall and two others in the opposite wall. Stretch copper wire between these and sling the net by rings on to these wires. In the day time the net is slipped along the wires to the foot of the bed and tied with tape at the foot during the day to prevent mosquitoes getting into it.

After getting under the curtains at bed-time, examine the inside to see that there are no mosquitoes.

If you can afford the luxury of an electric fan (and the use of these will soon be much greater all over India) place

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* "Let him not journey too early in the morning nor too late in the evening nor during the mid-day heat." (*Manu Samhita*).

the fan inside a large mosquito-net during hot weather. In this way you get coolness and freedom from mosquitoes. Living in mosquito-proof houses (that is, under an extra large mosquito-net in the daytime) is, in malarious places, very desirable. Have wiregauze of same mesh as mosquito netting nailed over all windows and have swing doors covered with the same. Doors and windows covered thus make the rooms somewhat hotter but help to keep out mosquitoes. This is so especially at night when the lights in rooms attract them from outside.

Do not sleep or live on a ground floor if you can avoid it. Do not sleep near ground that has lately been dug up. Do not live in rooms into which wind blows from marshes or other malarious places. For mosquitoes are blown in from their haunts in such places.

Turpentine soap is said to help to keep off mosquitoes for an hour or so after it has been used. Lemon-grass (or other "essential" or volatile) oil is used to smear on hands and face to keep off mosquitoes but after a little time evaporation of the oil makes it a useless protector.

White clothes are best in malarious regions for such attract mosquitoes less than colours. Boots are better than shoes (though, for tropical wear, less comfortable) as a protection against mosquitoes.

In a malarial district, take a course of quinine from time to time even though not suffering from malaria. Ten grains of quinine on waking in the morning may be taken by an adult every *second day*. Continue the course for at least 2 or 3 weeks at a time. Another plan much in favour is regularly to take five grains of quinine nightly during the malarial time of year. Quinine can be bought at any Post Office in India in packets of five grains for one pice. It can also be got at any Government Dispensary.

Malarial fevers occur especially in September and

October when the soil is beginning to dry after the rainy season. Then chills are very apt to occur during the cool nights which follow the hot days.

To sum up, our protection from malaria depends on :—

1. Taking quinine at malarial seasons, regularly ;

2. Sleeping under proper mosquito-nets ;

3. Removal of all breeding places for mosquitoes near the dwelling—draining pools and emptying all vessels in which the mosquito can breed ;

4. Good general sanitation as regards water, drainage, paving, conservancy, &c. ;

5. Good personal health-precautions—good food, suitable clothing, avoidance of over-exposure to sun and fatigue or excesses of any kind.

Sand Fly Fever. The female sand fly abounds in every season except winter in most parts of India and causes by its bites a fever which lasts three or five days and is very usually mistaken for malarial fever. *It, however, unlike malaria is not cured or prevented by quinine.* (Hence people taking quinine to prevent *malaria* and who get sand fly fever make the mistake of thinking quinine of no use to prevent "fever," that meaning to them malaria). This fly attacks the nose, ears and eyes particularly but also bites freely hands and feet or any other uncovered parts. It appears to breed in refuse and drains about dwellings, especially about kitchens. It also lurks in bathrooms and under stones and matting and in all damp, shady places. The sand fly may also cause blood-poisoning. The sand fly easily gets through ordinary mosquito-netting and so to protect against it a muslin ("mulmul") net is required. This is, of course, hotter to sleep under than mosquito-netting but a punkah can be arranged inside the net, if necessary.

It has recently been pointed out that powdered camphor sprinkled on the bed will keep off sand flies. No curtain, it

is stated, need be used. It is to be hoped that further trial will confirm the efficacy of this simple method of dealing with a most troublesome scourge.

In addition, care should be taken to see that house-walls and roofs are in good condition, as woodlice and lizards are known to be stages in the propagation of the sandy-fly, and are harboured by defects of dwelling-houses and surroundings.

Kala-azar is a disease particularly met with in Assam and the Duars. The symptoms are great weakness, bloodlessness with enlarged spleen; and fever occasionally. It has nothing to do with malaria, as used to be imagined. Quinine neither prevents nor cures it. The parasite which causes it is believed to be carried to man by the bed bug. Careful attention to sanitary matters and destruction of bugs are the only things to be done in the way of prevention at present.

Enteric Fever attacks Europeans much more than Indians. It has been shown to attack Indians much more frequently than was formerly supposed. Enteric fever occurs more during the hot dry months of April and May and also from August to October.

Young people suffer most from it. Meat-eating and spirit-drinking races are more subject to it. The germs of the disease are carried by means of water, dust, milk, food, or gases coming from drains.

Infected clothes also spread the disease and "carriers" are an important means of spreading enteric fever as well as cholera and dysentery. The "carriers" are *apparently healthy* people who have had enteric fever or been in contact with cases of the disease or have become infected with the disease in some way. They spread the disease chiefly by their fæces and urine, and may continue to do so for years. The germs are stored in their gall bladders from which they escape continuously or at intervals. Unless carriers are

cooks or food-suppliers they are not usually very harmful in countries where good sanitation (and a good drainage system) exists. In India they are always great sources of danger as their fæces spread the disease, as dust and by fleds etc., infecting food—especially milk and water.

The means of protection against this are those about to be mentioned for general protection from enteric fever.

Remember that the fæces and urine of enteric fever cases spread the disease and must therefore be rendered harmless by disinfection. If for instance a man gets enteric fever and his urine and fæces are thrown out near his house they get dried up, then caught up as dust and carried by the wind into wells, milk and on to food by flies as well as dust. They may soak into the ground and get into wells, or they may poison the ground-air and ground-water and this rising up into or near a house may cause the disease. The sputum, sweat, and other bodily discharges are, in a lesser degree, also infective.

The fæces and urine from an enteric patient continue to be infective for weeks and often several months after the person has recovered.

Cooking vessels or vessels for storing milk, water, ghee, etc., may be infected by washing them with bad water. Again the urine and fœces very readily soil bedding and clothes. Such clothes when moved or shaken cause the particles to be shaken into the air where they get breathed in or fall on food.

Again flies and other insects crawl on fæces or urine or other infected matter and then later infect food, water, etc. Mussucks, ghurrahs or other water vessels which cannot be properly cleaned may also cause the disease. These vessels should not be used for carrying or storing drinking or cooking water. Mussucks used for carrying dirty water to

water a garden are often used afterwards for carrying drinking water which is thus poisoned.

Cooks should be made to wear clean clothes when cooking. Kitchens should not be used as places for the cook to entertain his friends or to keep his dirty clothes. Collections of decaying animal and vegetable matter should never be allowed to remain near the cook-house, or dwelling. No latrine or foul drain should be near the kitchen. Flies will come direct from these and infect food, milk, etc.

The kitchen should have a paved cement floor if possible. Ice or lemonade or soda water, etc., made from foul water is a cause of Enteric fever.

Clothes should be washed in clean water and not in some foul tank or filthy river-side pool. They should not be stored in some filthy godown where infectious dust may fall on them. For the dust will be later shaken out into the air of the house and may convey infection. The latrine arrangements require special care (see Chapter IX).

Inoculation for this disease is our most valued means of protection. It protects for two years at least.

Inoculation period—about 14 days. In Enteric fever the bowel becomes ulcerated, that is, sores form in it. These eat into the bowel and may cause great bleeding or they may eat right through the bowel and thus kill the patient. The fever lasts several weeks, generally 3 to 4. There is often much looseness of the bowels but in many cases the bowels will not move without medicine.

Enteric fever requires most careful medical treatment and nursing throughout the disease.

Dysentery is also a highly dangerous disease caused by microscopic parasites. One form is caused by a parasite called an Amœba and another form by a bacillus. These are found in the ulcers or sores in the intestines which occur in this disease. The Amœba causes dysentery of a more

chronic nature in general and this form generally has the most dangerous complications. For the amœba frequently finds its way to the liver and causes destruction of portions of it. Pus or matter forms and an abscess is the result (abscess of the Liver is a most dangerous disease).

The type of dysentery caused by a bacillus is generally more violent in its symptoms and more fatal in its acute form.

Dysentery attacks Europeans and Indians freely. It is less fatal to Europeans. It is very dangerous to old people. There is always severe pain in the belly, and when motions are being passed this becomes very much worse. The motions are loose and contain blood and slime; and there may be a considerable number passed during the 24 hours.

The motions spread the disease and therefore require to be (*a*) *first disinfected and then burnt*; (*b*) or straightway burnt, where possible.

Dysentery may be either Acute or Chronic. It is brought on by chills, especially during the night, by eating putrid or irritating food, wearing wet clothes, and living in overcrowded rooms.

Natives of India often eat raw Indian corn and drink much cold water after doing so. The raw Indian corn is itself indigestible but when much cold water is taken with it the bowels may get completely stopped up and death may occur. Dysentery is also produced by this habit. It is also caused by drinking dirty or unwholesome water especially stagnant slimy water. Water into which fœces find their way is specially likely to cause it. "Brackish" water and water from the neighbourhood of a burying ground are specially dangerous. Dysentery is also caused by the stools of dysenteric patients, so such stools must be disinfected *immediately* after they are passed and then burnt. The bedding and clothes of the patient may also spread dysentery

as particles of motions on these get shaken into the air are breathed in or infect food or drink. Flies also spread dysentery. Free ventilation is particularly important in dysentery cases.

The house must be kept very clean and all decaying vegetable and animal matter round about it removed. People suffering from dysentery must be kept apart from healthy people. Those people who nurse them must be careful (just as in enteric fever) to wash their hands thoroughly before eating. Never eat in the room where the sick person is.

After the patient recovers or dies, the rooms in which he has been ill should be thoroughly lime-washed.

Too much animal food helps to bring on dysentery. Salted meat, "tinned" foods, and coarse *atta* are also liable to do so.

The food taken by a dysentery patient should be mainly milk, conjee, and arrow-root. Great care should be taken as to the food for some time after recovery as the disease readily returns if any indigestible food be taken. Plantains and milk mixed together often bring back an attack of dysentery. No stringy vegetables should be eaten ; and rice only if sufficiently old and well-husked. Fruit should be avoided, as a rule and above all if unripe or decaying.

Acute dysentery is often a very fatal disease, especially in very malarious districts or malarious times of year. Unless great care is taken even mild cases may pass into chronic dysentery which is a most dangerous disease, very often fatal. Boiling the drinking water and wearing warm clothing round the belly (especially at night) are precautions that should not be neglected.

Remember that extremes of heat and cold are specially bad for people who are inclined to get dysentery or who have the disease.

Lastly, it is to be noted that "carriers" spread dysentery in the same way as they spread cholera and enteric fever.

Consumption or Tuberculosis may attack the lungs, lymphatic glands, kidneys, brain membranes, bowel, etc. It is caused by a bacillus which causes inflammation and ulceration and abscesses. Fever and wasting of the body and great weakness occur. The bowel and brain membranes are more apt to be attacked in children. In grown-up people the lungs are more frequently attacked. One seventh of all the deaths occurring in the world are from this disease. All races and all ages are liable.

Infection occurs by breathing in air containing tubercle bacilli. The spit (sputum) is particularly dangerous for it is full of the bacilli. The sputum dries up and particles are caught up by the wind. When breathed or swallowed these cause the disease. Therefore all consumptive people in dwellings should spit into a vessel containing 1 in 20 carbolic solution ; or sawdust which can later be burnt. When out of doors they should spit into paper or rags carried with them which can be subsequently burnt.

The coughing of a consumptive person may infect another person through the air. Also wounds or scratches may be inoculated with tuberculous sputum, etc.

Flies coming from sputum, etc., may infect food or water and thus spread the disease. Consumptive persons should not eat ; live or sleep in the same room as healthy people : this is most important.

Cows may cause the disease through their milk. Milk should be taken only from cows in good health and with no sores on their udders. Consumptive persons should never be allowed to milk cows.

Boiling the milk, in any case, makes it quite safe. Butter is another channel of infection of importance, hence

great care in having it properly made is necessary (boil the milk from which it is made).

People suffering from consumption should not marry as the children of such a marriage are very likely to become consumptive. Besides the husband or wife is very likely to give the other consumption. A consumptive woman should never suckle her child.

Plenty of ventilation and sunlight; avoid overcrowding and damp houses; diminish dust; banish flies; precautions regarding sputum; good food (especially as regards using boiled or pasteurised milk) and proper clothing are all most important means of prevention.

Hydrophobia is got from the bite of a "mad" animal, that is, of one suffering from "rabies." The poison is in the saliva of rabid animals. The disease is common in India.

The animals which may give it are especially dogs, jackals, cats, wolves; and foxes, cows, horses much less often. The bite in man may heal and then after 15 days or more (often after as much as 8 months) convulsions may begin and death follows in 2 or 3 days as a rule.

The disease is called Hydrophobia from two Greek words meaning "fear of water." The fear of water is one of the symptoms of the disease in man *but not in animals*. A person suffering from Hydrophobia is never able to swallow water.

The symptoms are sleeplessness, pain in the scar of the bite, chocking sensation; and the person is unable to breathe freely. If the patient tries to swallow it may bring on convulsions. His saliva is thick and he spits it out freely. This is most dangerous for the saliva is full of the poison of the disease. He may have convulsions, or noisy raving, or paralysis before death.

Signs of a rabid animal. The poison is never in the animal's saliva sooner than 3 days before symptoms occur

in the animal. After symptoms occur, the animal rarely lives more than 2 to 4 days, and never longer than 10 days.

Incubation period—16 to 90 days in animals. At first there is little to be noticed—the animal is more timid than usual, its coat is rough and often smeared with mud from rolling as its skin tickles much. Later, it becomes bad tempered and very restless. A dog's bark becomes different—hoarse and muffled. It swallows with difficulty. The animal now runs about with sticky saliva dropping from its mouth and bites at everything it meets,—trees, stones, men, other animals. Pariah dogs attack everybody whom they meet. If it is a well-bred dog it usually vents its fury on its chain, bedding or by digging up the ground round about it. It quiets down usually before its master. If one sees such an animal coming and gets out of its way it will not follow and bite one. But if one meets it on the road it is very likely to bite one. The foregoing is the *furious* form of Rabies.

There is another form—the *paralysed* form—in which the jaws, loins and hind legs are nearly powerless (paralysed).

The animal always dies if it has rabies.

When in doubt as to whether a dog is rabid or not, do not kill it but tie it up in a room by itself (giving it food and water meanwhile, of course). In 10 days it will be dead if it is rabid. So, if the animal is alive and well 10 days after biting a human being, that person is quite safe. But a dog that has been bitten by an undoubtedly rabid animal should be kept under close observation for three months.

If a dog bites a person the custom is to kill it. The bitten person does not then know whether he has certainly been bitten by a rabid dog or not. Every dog that snaps and bites is not, of course, rabid but if dogs are chased they become frightened and behave in a way that may be mistaken for madness. Only one out of eighteen animals

bitten by a rabid animal will get rabies. Bites on the bare skin are more dangerous than if through clothes which wipe off the saliva from the animal's teeth.

When a person is bitten by an animal which there is good reason to think is rabid the wound should be freely rubbed with strong carbolic acid (or, less preferably, with lunar caustic [silver nitrate], potassium permanganate or pure nitric acid).

Then send the bitten person to the nearest centre* where he can receive the anti-rabic treatment *at once—the day he is bitten if possible.* The treatment is given to every one without payment. It is merely injecting through a hollow needle a prepared fluid under the skin. There is no pain except the prick of this needle. The treatment lasts several weeks. People being treated do not go into a hospital but can go about freely all the time.

Remember that the sooner the special treatment is begun the better is the chance of preventing hydrophobia.

The treatment is quite harmless and has, since it was started, saved many thousands of lives. If symptoms of hydrophobia have set in, it is too late for anti-rabic inoculation.

Measles is a fever caused by a germ. A rash comes out first on the forehead (small pimples) and then covers the whole body. The eyes and nose water freely and there may be a cough as well.

The disease is got through the air from persons suffering from the disease; and by infected bedding, clothes, milk, food, or from badly ventilated rooms in which cases have occurred.

It is very infectious and so persons having the disease

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* **Pasteur Institutes at Kasauli (Punjab), Coonoor (Madras), etc.**

must be kept apart for four weeks from the start of the disease.

Incubation period—1 to 3 weeks. The breath and the dead flakes of skin of patients are particularly dangerous. Rubbing the body over with vasline, therefore, lessens the chance of infection from the skin. It is not often fatal in India.

Mumps is a very infectious disease but is not dangerous as a rule. It is very common in some hill stations in India. It is a feverish disease with much swelling of the glands about the jaw. The breath is most infectious.

Incubation period—2 to 4 weeks. The patient should be kept away from other people for three weeks altogether. One attack protects from another for life usually. Young children are specially attacked but adults in India suffer from it to a considerable extent.

Pneumonia or Inflammation of the lungs is a very fatal disease among Indians and less so among Europeans.

It may become epidemic in over-crowded houses which are badly ventilated. Cold often greatly helps to produce it. The breath and sputum are infectious.

Influenza is a kind of "feverish cold" in which there is much fever and headache, and weakness which lasts a long time. Pneumonia and Bronchitis very frequently occur along with it. It occurs in epidemics. Great care must be taken to keep in bed *while the feverishness lasts* and not to go about too soon as recovery is always slow—lasting over 3 or 4 weeks.

Incubation period—1 to 5 days. The breath and sputum are very infectious. The patient should be as much as possible kept apart from others and can give the disease for about 2 weeks from the date of attack. It is very dangerous to old people.

Very young children generally escape. No protection

from a second attack follows. Good food and free ventilation and no overcrowding and a regular life are specially important means of guarding against this disease. During an influenza epidemic taking a teaspoonful of Ammoniated Tincture of Quinine once a day is a useful precaution.

Leprosy is due to a bacillus. It rarely occurs in children under 5 years of age and generally does not attack people over 40.

The skin has an eruption of spots and later white patches form. Then ulcers eat through the fingers, toes, arms and legs which in time shrivel and drop off. It is not hereditary. Lepers should not be allowed to carry on trades in which they can infect other people. They should not be allowed to sell or touch food or clothing or to be barbers or dhobies ; or to attend fairs or other public gatherings. Eating putrid or dried fish is said to be one cause of the disease but this is not yet satisfactorily proved.

Sick-room. The room in which an infectious case is to be nursed should be first emptied of all furniture that can be spared—all carpets, dharris, clothes, curtains, books should be taken out.

The room should be kept very well ventilated and clean.

People attending the sick man should never take their meals in the sick-room. As a rule they should not stay with him longer than 3 hours at one time. (See also Chapter VIII, *Birth-room*).

Prevention of Infectious Diseases—

By Segregation. Here the sick people and their attendants or those who have been in close contact with them are kept apart from all others until there is no longer any risk of infection being spread by them.

This is often carried out in what are called segregation camps or in hospitals.

Isolation of the infected person is one of the best means

of preventing the spread of an infectious disease.* Where such separation from others is impossible (as in poor people's houses where a room cannot be given up to the sick man alone) it is much best to send the sick person to a hospital where such cases can be treated. If the patient is not separated from others it is obvious that he will give the disease to others. In this way a bad epidemic is often started, killing perhaps hundreds of people. Such deaths as these should never have occurred for the spread of infection can certainly be prevented in all cases. It is the cruel selfishness, fatalism and ignorance of people about such matters that causes so much suffering to other people. It is strange that such selfish people cannot see how dangerous to themselves and their families it is not to isolate any infectious case. In India there is much foolishness and ignorance on the subject of going to hospital. Many ignorant people think that if they go to hospital they will be sure to die. Generally more people *may appear* to die in hospital than out of them. The reason is this. Only very serious cases of illness are taken into hospital. Such cases are of course much more likely to die outside a good hospital but in any case such serious cases are apt to die whether in or out of hospital. But they will be better treated and fed in hospital than at home as a rule. So they will have a better chance of recovery, and unless there is a good room and good nursing to be had at home it is best and safest for the patient and his family for him to go to hospital till he is better.

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* All nations have found this out by bitter experience.

The Greeks, according to Herodotus, excluded a person suffering from an infectious disease until cured and cleansed according to the rites.

Again the Zend-Avesta: "The unclean people with infectious diseases or men who have touched them, etc., are to be confined in a place apart from all clean persons and objects."

Notification of Infectious Disease. This means writing to let the Health Authorities know that there is an infectious case in a house. This is not likely to be much attended to by Indians until they know that petty municipal and other officials throughout India will not abuse the power thus given to them. It is partly ignorance and also fear of hospitals and of extortion by petty officials that will delay the adoption by people in India of notification of infectious disease.

DISINFECTION.

This means the killing of germs and their spores by substances known as *disinfectants.*

Three agencies are described for the purpose :—

1. *Deodorants* which destroy bad smells without destroying germs, for example, charcoal, vinegar, &c.

2. *Antiseptics* which stop the action of germs but do not kill them, for example, boracic acid.

3. *True Disinfectants* which destroy germs, for example, mercury perchloride, carbolic acid, &c.

As regards Disinfectants, these are classified as—

(*a*) *Natural,* as sunlight, fresh air and drying ;

(*b*) *Physical,* as fire, steam, boiling or hot air ;

(*c*) *Chemical,* which may be gases (sulphur fumes, formaldehyde, chlorine), liquids(corrosive sublimate which is mercury perchloride, carbolic acid, cresol, phenyle) ; or solids (potassium permanganate, lime, soap).

Fresh air is a slow but powerful means of disinfection. It acts by oxidation.

*Sunlight** or drying can kill germs but *not* their spores.

Next, regarding physical disinfectants.

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* "And when the sun rises up then the earth, the running and standing water become clean." (*Zend-Avesta*).

Heat is the best way of all. It may be employed as moist heat, that is *by steam*. It may also be carried out by *boiling* the infected substance or by *dry heat* as in an oven, or hot air room. Fire is the most thorough disinfectant.

Hot dry air is the least useful method as we need at least the temperature of boiling water—212 degree Fahrenheit—and this destroys many of the substances which are being disinfected.

Boiling is much better. If clothes are to be boiled, soak them first in cold water and *Sajimatti* (or 'washing soda'). Then boil for an hour. (Boil also the water the cloths have been first soaked in).

Spore-bearing germs are not destroyed by one boiling and it is safer to *boil again* after waiting a few hours.

Ordinarily, however, one boiling for an hour is sufficient.

Steaming is a most useful method for it penetrates the article to be disinfected more than can be done by the other means of applying heat. A lower temperature is needed than in the case of dry heat. There is also less risk of fire. There is generally less damage to most of the materials which are being disinfected. It penetrates articles to be disinfected far more effectively than hot air, and far more rapidly.

Steam disinfection, however, has the drawbacks that it requires an expensive apparatus and a man specially trained to work this. It also causes many woollen stuffs to lose their colour and shrink. Also leather, cottons, silk, linen, India-rubber all suffer from the steam. Steam disinfection must generally be carried out by the Health Authorities of a place as the apparatus is expensive and requires a skilled workman to work it. The best apparatus is the Washington-Lyon or Thresh's or the Equifex. The latter is frequently used. In it steam is turned on under a pressure of about 10 lbs. and in five minutes the temperature inside

is 120 degrees C. The articles to be disinfected are steamed at this temperature for 20 or 30 minutes. The Thresh apparatus is cheaper than the other mentioned. Steam is used in it a few degrees above the boiling point of water—not under pressure but by using a solution of salt which causes boiling at a higher temperature than water alone. Twenty minutes is enough and afterwards hot air is drawn through to dry the articles.

But *wherever possible* it is best to *burn* all infected articles if of small value. If burnt, soaking in kerosine aids in the case of articles difficult to burn readily.

Articles removed to a disinfecting station should be placed in canvas bags (like Indian post-bags). These bags should preferably first have been brushed over with gum on the outside to make them more impervious.

Chemical Disinfectants. Bedding or clothing should be soaked for a day and a night in any of the following solutions :

Perchloride of Mercury : ½ oz. in 3 gallons of water (that is, of a strength of 1 in 1000). See below also.

Carbolic Acid : a five per cent. solution, that is five parts of carbolic acid in 100 parts of water. Both the above are powerful poisons, so great care should be taken in using them.

Izal : a liquid which turns the colour of cream when water is added to it. It is not irritating and is non-poisonous. Use it in 1 per cent. strength for spraying rooms ; and 2 per cent. for disinfecting sputum in phthisis cases.

Instead of steeping in any of the above solutions, we may *boil* the clothes and then wash well with soap and hot water.

Formaldehyde* is a good disinfectant for blankets and

* Another name for this is formic aldehyde.

for applying to books and boots. Use it in 2 per cent. solution, that is dilute the formalin sold in Chemist's shops about 15 times with water. Blankets should be steeped in it for ½ an hour. Leather articles should be wiped over with a 2 per cent. formalin solution.

Formaldehyde is a dangerous poison so care must be taken in using it.

Saponified Cresol is a tar-oil preparation which is cheap and effective—more so than carbolic acid and less poisonous.

Be careful not to leave any of these poisonous disinfectants where accidents may occur by children or others drinking the colorless fluid by mistake for water, &c.

Disinfection of stools, vomit, etc.

Perchloride of mercury solution should be coloured blue with aniline blue to prevent poisoning accidents. Use it according to Parson's Formula:

Mercury Perchloride	½ oz.
Strong Hydrochloric acid	1 oz.
Aniline blue	2 grains.
Water	3 gallons.

Mix the Perchloride of Mercury with the Acid first and then add the water. This is intensely poisonous from the Mercury Perchloride: and the acid will destroy metal surfaces.

Carbolic Acid. 1 part to 20 of water may be used. Mix either of these with the stools, vomit, etc., in equal parts and allow to stand for half an hour—not longer. Then bury deep—far from any well or house; or burn.

Best of all, mix the stools well with saw dust and burn at once.

Disinfection of Houses and Furniture. Picture frames, wooden and metal substances, glass and crockery should be well brushed over with Carbolic acid solution, 2 per cent. Then wash well with soap and hot water. Valuable fabrics,

silks, etc., should be spread out for several hours in the sunlight.

A room should be disinfected as follows :—Never allow the room to be swept and dusted before disinfecting it for this only stirs up the dust and makes it more dangerous to enter for the people who are disinfecting it :

1. Ventilate thoroughly.

2. Scrape the walls and floor thoroughly and bury the scrapings later. Do not dig up the floor.

3. Spray the walls and floor with a hand pump apparatus or syringe, using carbolic acid (1 per cent. solution) or formalin. (If using formalin put on goggles to protect the eyes and cover the mouth with a moist handkerchief).

4. Next day lime-wash the walls.

Workmen on disinfecting duty should :—

(*a*) have special clothing for their work. This should be changed when the work is done and the body should be well washed with soap and water.

(*b*) they should wrap a fold of puggri over the mouth when entering a house.

(*c*) On opening a house to disinfect it, spray or splash the disinfectant solution on the floor and walls before entering. This will help to lay the dust and make it safer to enter room.

(*d*) Shoes should always be worn.

(*e*) Oil the hands to protect them from the Carbolic solution, if used.

(*f*) Wash the hands well after work.

(*g*) Do not eat or smoke in the infected house.

Fumigation (or smoking the room with some chemical) is always uncertain in its effects. It must be understood that it is never enough to merely fumigate. The room must also be cleaned and thoroughly ventilated. It is the room's

contents and the roof, floor and walls that are to be disinfected. The air of the room can be changed by ventilation and hence does not need disinfection. Earthen floors should be soaked well with 1 in 1000 mercury perchloride solution, or other powerful agent.

Chlorine and Sulphurous Acid gases are those usually used. Both attack metal fittings in a room and will bleach cotton or woollen materials.

Chlorine Gas is most easily got by pouring ½ lb of strong sulphuric acid on 1½ lb. of bleaching powder. This amount will fumigate 1000 cubic feet of space. *The wall and floor must first be well wetted with water.*

Sulphurous acid gas is got by burning 2 lbs. of sulphur for every 1000 cubic feet to be fumigated. *It is necessary to wet the walls and floors first with water.* It is then a good (though often it proves to be a rather uncertain) disinfectant. (1 lb of Sulphur to 1000 cubic feet is often recommended but this is not strong enough).

Formic Aldehyde (as tablets or as "formalin," a 40 per cent. solution) is the best of these fumigators but is much more expensive than sulphur fumigation. It may be readily obtained by pouring 2 parts of formalin on one part of potassium permanganate. For each 1000 cubic feet of air-space, use half a pint of formalin and five ounces of permanganate, mixed in an ordinary metal bucket. Pour the formalin on the powdered permanganate. Be careful to cover the mouth and to wear close-fitting spectacles while doing this for the formaldehyde is very poisonous to breathe in and is irritating to the eyes. Expose the room to the formalin gas for six hours at least.

The Lingner apparatus is another means for rapid and thorough disinfection by formalin.

To disinfect drain pipes use a solution of ferrous sulphate ("green vitriol")—1 lb of it to 1 gallon of water. *Do not*

use bleaching powder ("chloride of lime") or mercury perchloride for disinfecting drains as they may get into the water supply, if the drains are leaky, and cause poisoning.

To disinfect wearing apparel, boil for one hour.

For cooking and feeding vessels, boil for half an hour.

Bedding from cholera, enteric fever etc., cases. It is safest to *burn a razai,* mattress or matting. *Blankets* may be thoroughly disinfected by boiling for one hour. Steeping in 2 per cent. formalin solution for half an hour is another excellent way. Potassium permanganate (in 5 per cent. solution) is very useful. But it is expensive and stains most cloth and other articles badly.

Of the solid disinfectants, lime must be used when freshly-burnt, otherwise it absorbs carbonic acid and forms carbonate of lime which is useless as a disinfectant. The oxide of lime in freshly-burnt lime is a powerful germ killer, and cheap. As whitewash for rooms it is one of our most useful disinfecting agents. The walls must be well-scraped before whitewash is applied.

Chloride of Lime is, if fresh, a good disinfectant but in India it rapidly deteriorates and becomes useless in many cases. It cannot, therefore, be recommended for use in India, unless freshly made.

For the destruction of insects, Pesterine ; Kerosene Oil Emulsion ; Petrol ; Kerosene oil and Cyanide of Mercury Emulsion ; Sulphur Dioxide or formaldehyde gas are all well-tried agents. Several of them have already been referred to under Plague and other headings.

As regards the Emulsion of Kerosene and Cyanide of Mercury, this is made by mixing two parts of the cyanide with a hundred parts of kerosine oil emulsion. It is a very powerful disinfectant as well as one of our best insecticides but is somewhat costly.

CHAPTER VIII.

PERSONAL HYGIENE.

Habit. Regular habits are a great aid to good health. The body acquires habits and works best when these habits are not interfered with. The stomach gets into the habit of expecting a meal at certain times of day and prepares itself beforehand. It then digests the food better for being ready. Again the bowels should be got into the habit of acting every day at the same time. This habit will aid them to act when otherwise they might not. This is a most important habit to acquire. Then again the body gets into the habit of expecting so many hours of sleep and the body makes itself ready to fall asleep at about the same time every day. This habit is specially important. Regular exercise becomes a habit and the body gets to expect its exercise at the same time daily.

Again the mind forms habits as regards work ; and regular work (short of fatigue) keeps the nervous system working much better than if it had no regular work to do. Idleness and indolence are two of the greatest enemies to health.

What the body does as a matter of habit it does more easily and with less exertion.

We grow tired sooner of work which is new to us. The reason is—we need to put forth more energy to do a thing for the first time. *An action that we have done often before is done with far less effort and less waste of energy.* For instance, a child learning to walk puts forth far more energy than one who has learnt to walk. Walking becomes a *habit* and is done unconsciously and more easily. By habit all work is made easier and less tiring.

Bad habits are easily formed but are difficult to give up. Take the bad habit of swallowing food without chewing it first. It will require much attention every time we eat to break us of this bad habit.

Exercise. Unless we take exercise our bodies get clogged with waste substances. By taking exercise we help the body to get rid of these just as a fire never burns well until we take away the ashes ; so with our bodies. We also keep every part of the body in better working order by exercise. Our digestive organs, lungs, heart, brains, muscles, all benefit by healthy exercise that is, *which does not cause overfatigue*. Any exercise is bad which tires us so much that lying down or resting for 20 or 30 minutes is not enough to restore us. So we must take care not to take too much. But there is much less chance of taking too much than too little, especially in India.

When taking muscular exercise our lungs expand more widely and more air is drawn into the chest. Our tissues get more oxygen and more of our energy is used up.* Proper food is needed to replace this. Fresh air is necessary if exercise is to do us good.

Again our hearts act more forcibly and beat quicker during exercise. Our skin acts more freely. It becomes full of blood and the perspiration increases very much in amount. This tends to keep us cool, but we must remember that there is *also* a great danger of chill, if we do not put on sufficient dry clothes after exercise. Neglect of this causes an immense amount of illness. *It is one of the commonest causes of fever, diarrhœa, dysentery, etc., in India.*

So long as we are actually taking exercise it does not

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* By exercise the body acquires lightness, activity, good digestive power, diminution of fat, suitable proportions and firmness.

(Astanga Hridaya Samhita).

matter that our bodies are covered with sweat and our clothes damp. But when we stop and perhaps sit down while hot and perspiring we get a bad chill. For the heat caused by taking exercise is no longer being made by our bodies and we therefore chill rapidly. To prevent this, dry the perspiring body with a towel and put on dry clothes.

It is better, broadly speaking, to put on too many rather than too few clothes. Gymnastics and other active muscular exercise should always be stopped *before we feel very tired.* If not, they do harm rather than good.

When breathing becomes difficult and deep sighs are taken it means that the lungs are too full of blood and the heart over-worked and that we should rest.

When we do not take sufficient exercise of body and mind we rapidly lose our appetite for food ; the bowels do not act well ; and we feel much less inclined to take exercise. We get poisoned by our own waste-materials. This poisoning is often shown by bad or irritable temper. If, at the same time, we eat much more than is needed (as is nearly always the case) we suffer from irritation of the stomach and bowels in the form of indigestion and diarrhœa. Our livers also become too full of blood and poisonous waste materials (and this may proceed to inflammation or even abscess). Much of our food goes to form fat when too little exercise is taken. The very fat people we so often see driving about or being carried about become so from taking too little exercise and too much food—especially, rice, sugar, ghee, etc.

Clerks and Indian students, especially those preparing for examination, often suffer much from want of exercise. Some of them suppose that all their time should be spent in study. This is wrong. They will work better and their minds will be clearer if daily taking exercise in the open air. A man as a rule ought to take an amount of exercise in the day equal to a walk of nine miles. This rule, however,

does not apply to India in the hot weather and rainy season. Then about half as much exercise will be enough, for our hearts and nervous systems are for the time feebler on account of the great heat and, in some places, dampness.

The kind of exercise we take should not always be the same.* By changing it we use different muscles which is a great advantage. Cycling, walking, tennis, cricket, football, golf, rowing, badminton, hill-climbing, swimming, riding, hockey or gymnastics—wrestling, dumbbells, Indian clubs, *hadu gadu*, *chu-kapati*, fencing—are all excellent. Indians are beginning to use and enjoy European games as much as Europeans.

But these must not take up too much time. Two or three hours a day is generally enough for such exercise. The mind must also have exercise. When the body is exercised the brain also benefits by having its waste-products removed and its nutrition and activity increased. Be careful not to continue violent exercise too long at one time. This causes more harm than good and many at last cause a form of heart disease from overstrain ; or may lead to the breaking of a blood vessel in the lungs or elsewhere.

Pure water is the best drink to take when thirsty during or after exercise. Do not drink a large quantity of cold water when very hot from exercise. This is very dangerous and has even killed people. When thirsty, during or after exercise, sip water slowly and it will quench the thirst much more. Alcohol is a bad thing to take while exercising as it lessens our power of doing work then very much.

Exercise, if to be severe, should not be taken until at least an hour after a heavy meal. It should not be taken when the stomach is empty as this causes us to become tired too quickly. A light meal may be taken shortly before any

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* See Appendix I.

exercise which is going to last 2 or 3 hours. Loose light clothes should be worn while taking exercise so as to leave the body's movements as free as possible. The clothing should be able to absorb as much of the sweat as possible; therefore flannel or woollen garments of light weight are best.

Short periods of rest should be taken during a long spell of exercise.

Remember that muscle power and will power are very closely connected so that the action of the muscle ought to be *consciously* directed by the mind.

Violent exercise of mind as by study should not be indulged in at mealtimes.

Lastly, students should never leave work too much to the last before an examination. Often students are idle and lazy throughout the session and try to make up for this at the last by *cramming* or learning by memory and without understanding what they learn. This is a mistake from every point of view. The brain is often over-taxed and the student gets confused and breaks down under examination. Keep up your work from day to day. Revise your work once every week or two. Steady work of this sort is best and "pays best" in examinations and later. This is the way the brain likes to learn and therefore the way it learns best. All mental training is a slow process and constant repetition is a most important part of learning. Remember lastly that the early morning is the best time for work, for the brain is freshest then after sleep.

It is best not to work for more than about an hour at one time. Then take five minute's rest and go on with a fresh subject if possible. About six hours a day of brain work is as much as we can do well.

Sleep. People of different ages need different amounts of sleep. Children and old people need most. The child's

brain is growing rapidly and to help this the quiet of sleep is needed. Old people need more sleep because as people grow older they need longer to make up the energy they have lost while awake.

Sleep has been rightly called "tired nature's sweet restorer" and so after hard work of body or mind it comes naturally and is most necessary.*

But *immediately* after hard work sleep will often not come. We require to get calmed down before falling asleep. The amount of sleep needed at different ages is usually as follows:—

Infants	16 hours sleep during the 24 hours.		
At 2 years old	14	,,	,,
4 ,,	12	,,	,,
7 ,,	11	,,	,,
9 ,,	10½	,,	,,
14 ,,	10	,,	,,
17 ,,	9½	,,	,,
21 ..	9	,,	,,
24 up to 50	8	,,	,,

Later than 50 years of age 10 hours sleep during the 24 hours.

Women need slightly more sleep than men, about an hour longer as a rule.

The need of sleep is that during sleep the waste of our organs is made up. While we are asleep the different organs are working much less actively and some get complete rest.

Sleep varies in depth or soundness at different times. At night when we first fall asleep we sleep much more soundly

* Health depends on sleep. Sorrow from bad health, want of strength, want of manliness may depend on insufficient sleep. Sleep at an untimely hour, too much sleep or want of sleep: these destroy health and long life. (*Astanga Hridaya Sutra Stana*).

and it is then more difficult to wake us up than later. At the end of the first hour's sleep we are in our deepest and most refreshing sleep.

Want of sufficient exercise and indigestion are two of the commonest causes of not being able to sleep. Heat, want of fresh air, worry, strong coffee or tea taken within a few hours of going to bed (or small doses of opium or Indian hemp) are other very common causes of sleeplessness.

Night is the natural time for sleep as it is the coolest time of the day ; and great heat prevents sleep. We soon get ill from not sleeping well. Our sleeping-room should be well darkened, quiet, as cool as possible in hot weather, with plenty of space and of fresh air.

Before going to bed for the night, do not do any hard mental or muscular work.

Do not take a heavy meal within 3 hours of going to bed.*

Have as little furniture as possible in your bed-room for it takes up air and shelters mosquitoes.

Dirty clothes should never be left in the bed-room to poison the air.

Do not keep lamps burning all night in a bed-room for they eat up the air and also poison it.

Charcoal fires are most poisonous (because of carbon monoxide gas) and should never be allowed in a bed-room. Many deaths occur in India through ignorance of this.

The practice of sleeping *in the day time* is one generally to be condemned. It often spoils the night's rest. It causes indigestion if such sleep is indulged in after a heavy meal. But an *occasional*, very short afternoon sleep† when

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* "He must not sleep while the remnants of food are on his hands or face, nor in the day time, nor in the twilight nor upon ashes, nor in a place soiled by excrements, nor in a wet place, nor in a burial ground, nor in the open air, nor naked nor with wet feet."

Institutes of Vishnu.

† Lasting not more than 20 to 30 minutes at most.

one is hard worked or not sleeping well at night may be advisable. It is however, *for most people*, a bad habit to acquire, though some people do not appear to suffer from indulging themselves in this way.

As to the bed, it should be moderately hard, with clean cotton or linen sheets. The pillow should be moderately high and not too hard or too soft.

The healthiest form of bed is one of iron or brass with a metal open-work, spring mattress and on the top of that a hair mattress. There should be no ornamental curtains or doors to close in the bed, and keep out fresh air. *Niwar* or tape for the bed may be used but must be occasionally taken off and cleaned by boiling and drying in the sun. String is bad as it harbours parasites. Good cheap mattresses may be made of chopped straw in a cover of drill cloth. The straw of these must be changed every few months and burnt if the mattresses are to remain clean and fresh. When *soiled* by fæces or urine the straw must be changed and the cover washed. Matting is also used spread over the *niwar*. It ought to be shaken and placed daily in the sun for some time. Mattresses should be turned and shaken every morning. Wool or horsehair make excellent stuffing for mattresses.

Do not sleep on the floor, which may be damp and cause rheumatism, fever, diarrhœa, dysentery, etc. Besides poisonous ground air is more likely to be breathed. Again there is the risk of being bitten by scorpions, centipedes, snakes, fleas (see plague), cockroaches, ants, etc. People who sleep on upper floors suffer much less from malaria, plague, dysentery, diarrhœa, etc.

A *chaddar* or a flannel belt should always be wrapped round the belly at night to prevent chill as the night gets colder. Light, warm bedclothing should be used and should be well aired and dried in the sun everyday.

Never cover up the head with a sheet at night. By so-doing the air under it is breathed again and again and this is most unhealthy, and may predispose to lung diseases.

Dogs and other animals should not be kept in the bed-room as they help to use up and poison the air.

Never allow any cooking to be done in a bed-room.

Air should flow freely all round and under the bed.

Lie mostly on the right side of your body and not on the back or left side. When you lie on the right side the heart can work more freely and any food left in the stomach can leave it more easily.

Two people should not sleep in one bed. They breathe each other's breath and, if restless, prevent each other from sleeping soundly.

After getting out of bed have all the bed clothes removed, shaken and placed in the sun for some hours.

Mosquito-curtains should be used in seasons when mosquitoes occur. Place your bed in a slight current of air or else the air under the mosquito-curtain will not be changed often enough. A hand-drawn or electric punkha can be used inside a mosquito net in the hot weather and rains. Do not sleep in the open air in damp localities. Where it is so hot that sleeping in the open air is required as in hot, dry climates, such as the Punjab, Sind, etc., during the hot season, sleep on a *chibutra* rather on the roof. Have a piece of canvas (as broad as the bed) stretched about 2 feet above the bed to help to keep off dew.

In Lower Bengal, Bombay, Madras, Assam and Burma, sleeping out of doors at any season is generally dangerous because of chills got from the heavy dews.

A verandah is a good place in which to sleep during the hot weather. Never get into the *habit* of taking drugs to cause sleep, as this will quickly ruin your health.

Washing.

Baths :* A cold bath is one below 65° Fahr.; a tepid bath between 80 and 90° Fahr.; a warm bath between 90 and 104°; and a hot bath between 104 and 110°.

The whole body should be washed with warm water and soap once a day; and the feet, face and hands oftener. If this is not done the dried up sweat and fatty matters of the skin collect and prevent our bodies sweating freely. They also poison the air by the amount of organic matter given off by them and their smell is horrible.

Dirty people who never take baths *seem* to be not much the worse. But they have a lower standard of health and are much more liable to infectious diseases than people who keep their bodies clean. Do not use coarse soaps for washing the skin. If any soap makes the skin tender or dry you will know it is doing harm. It is never too cold to bathe indoors and bathing must be continued all the year round. Never put on wet clothes after bathing. This is a most dangerous thing to do and often brings on fever.

It may often be enough to wipe the body well with a piece of flannel or a sponge and then rub dry with a rough towel. Cold baths are too severe for most people in India. But rapid sponging with cold water and then rubbing the skin dry with a rough towel is very good. Warm baths

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* *The Institutes of Vishnu* forbid Hindus to bathe while suffering from illness of any kind: or at night: or in the twilight. They ought to bathe in the morning at sunrise. They must not put on the clothes they wore before bathing. They must put on clean, dry clothes.

They must bathe in running water. The water of a spring is purer than that of a tank but river water is best of all. They must bathe and put on clean after having touched a corpse.

The Zend-Avesta forbids people to drink from the same cup as others especially if the cup be wooden or earthenware (that is, porous enough to absorb poisonous matters from the mouth of another). Ceremonial washings of the different parts of the body are required by all religions.

cool the body *afterwards* as the warm water makes the blood vessels of the skin become full of blood and a lot of heat is thus lost from them. Sponging the body with cold or tepid water is used to cool the body in fevers ordinarily. Baths should not be taken during fever, but the body may be washed, bit by bit, with warm water.* A bath should never be taken after meals for this upsets the proper working of the stomach. Manu's Laws lay this down and all experience confirms its wisdom. A little Ammonia solution added to the bath makes it more refreshing.

Russian baths are steam baths ; and Turkish baths are *hot air baths.* Both kinds are followed by rubbing the body and plunging it in cold water and then resting quietly afterwards. This cleanses the body very thoroughly. People with heart disease should be very careful of these baths as they often are very dangerous to them.

Rain water is best for washing and it uses up less soap. Boiling softens most hard water and makes it better to wash with.

The teeth should be well brushed at least twice a day with a tooth brush rubbed on a piece of soap. A tooth-pick (quill or soft wooden,—*never metal* which makes holes in the teeth) should be gently used to clean between the teeth. A piece of string passed between the teeth may also be used for this purpose. This removes particles of food which will otherwise rot the teeth and give bad toothache and later cause us to lose our teeth. When the teeth fall out we may get artificial teeth made and fitted by a dentist or else digestion may become bad as we cannot chew our food properly.

The nails are best kept clean by keeping them cut short

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* "The man who bathes regularly acquires ten virtues, namely, beauty, stoutness, strength, energy, freedom from disease, long life, steadiness of mind, freedom from evil dreams, austerity and memory." (*Daksha Samhita*).

—flush with the finger tips. Soak out dirt by soapy water, rather than by using a nail brush. The nails should not be cleaned with a knife or other hard substance as this raises the nail from its bed and dirt collects more easily afterwards. Finger and toe nails should be kept cut short and somewhat square. If this is not done the nails get broken or grow into the flesh and give much trouble. The finger nails should be kept very clean as filth lodges under them. Thus they may poison our food and cause serious and often fatal diseases.*

Hair. In India there is an excellent custom to shave off the hair of the body. This is cool and cleanly. But the hair of the head requires special care. It should not be washed more than once a week. The yolk (or yellow part) of an egg is best for the purpose. It is to be well rubbed into the hair and then washed away with water. After a bath a little oil should be rubbed into the roots of the hair. This will make up for the loss of the natural oil of the skin which washing has removed. People who wash their heads everyday get bald rapidly as the hair gets dry and falls out when its oil is removed. The hair should at other times be kept clean by brushing with a *moderately* hard brush. This should be done *at least* twice a day.

Tight or very heavy hats and puggris are bad for the hair by pressing on the blood vessels which nourish its roots. The hair thus dies and falls out. The head should be left uncovered (when out of the sun) as much as possible.

The ears should be cleaned on the outside and at the opening of the ears. Water should not be poured into the opening of the ears. Never clean the *inside* of the ear except with the finger-tip.

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* "Keeping his hair, nails, beard clipped, subduing his passions by austerities, wearing white garments are all ordered by the Laws of Manu.

Spread of disease by insects. (In an elementary book like this a full description of the anatomy of, and other details regarding, insects would be out of place. All the chief practical points bearing on the prevention of disease by insects have, it is believed, been dealt with in the various sections of this book).

Lice live in clothing and bedding and occur most on people who seldom wash their clothes or who do not change them for sleeping. Lice live entirely by sucking blood and are the means by which relapsing fever and typhus fever are chiefly spread. This latter is rarely seen in warm climates but in cold climates it is a very fatal disease. Lice, infesting either the head or body, are commonest in winter when clothes are least often changed or washed.

Lice die rapidly in very dry air : or if the air is warmer than 77 degree Fahr. (25 Cent.), unless it is also very moist. They feed several times a day on their victims but die it starved for two days. The female louse lays up to 200 eggs, which are hatched in 1 to 5 weeks (according to the air's temperature).

Bugs are blood suckers like lice. They attack people by night. They greatly dislike light and hide during the day in cracks in the walls, roof or furniture. The bug is suspected of carrying plague as well as the rat flea. The bug has one considerate habit as regards man. It does not add insult to injury by emptying its bowels when sucking man's blood. Fleas and lice, however, do so and as their fæces are usually full of germs this is a great extra danger to man. Thus the rat-flea's fæces have repeatedly been proved to contain plague bacilli and these are rubbed into the bite by scratching or the skin is broken by scratching and infection occurs in this way. Bugs may also spread tuberculosis, leprosy, kala-azar, and typhus fever. Unlike lice, the bug can live for months without feeding.

To remove lice and bugs.

Head lice : Cut the hair very short* and soak the scalp with kerosene oil and olive oil in equal parts. But be most careful not to go near a lighted candle or lamp or there will be an accident and such have frequently in the past proved fatal. Then comb the hair with a fine-tooth comb, dipped in vinegar, which unfixes the eggs from the hairs.

Turpentine or carbolic lotion (1 in 40) are also useful instead of kerosene. Great care and cleanliness must be taken for some time to prevent recurrence.

Body lice : Rub the skin with carbolic lotion (1 in 40) and boil the clothes for an hour.

Crab lice occur on the short hair on the body (especially of the belly) : rub in mercurial ointment ("blue ointment") and wash twice a day afterwards with soap and water freely.

Bugs. Fumigate with formaldehyde. Tar may be applied to cracks or inject carbolic lotion (1 in 20). Stop up cracks in walls and roof with plenty of cement. Cocoanut oil smeared over places inhabited by bugs will usually remove them.

Flies.† The house fly lays about 120 eggs each time and may produce four such broods. The eggs are hatched out in under 24 hours as a maggot or larva. This turn hatches into the pupa stage (a red barrel-shaped body about ¼ inch long) in from 3 to 5 days. These stages depend for their length on the degree of warmth and moisture and food obtainable from refuse. When finally hatched out, the fly at once flies off seeking for food.

The eggs are chiefly laid on manure heaps or rubbish of any kind. Hence the necessity for removing all such from

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* In the case of women the hair need not be cut but extra care must be taken to rub in the kerosine mixture thoroughly.

† *Hindu Proverb :* "The scorpion bears poison in its tail, the fly in its head."

round about or inside a dwelling. The family of the fly may amount to *twelve million* of about 800 lbs. weight of flies produced within two months.

The fly also freely deposits fæces on the skin or wherever it may alight to feed and it also vomits at the same time.

Both fæces and vomit are full of germs so that it is not surprising that the fly is one of the greatest spreaders of disease known. From the dunghill where it is born it flies to the nearest food—milk, sugar or fæces. Its hairy feet and its vomit and fæces are its means of carrying the infection of enteric fever, cholera, ophthalmia, diarrhœa, dysentery and many other diseases. In the adult form, flies can live in winter in houses, lurking in dark places.

Flies must be kept away from sick and well people alike. In order to do so the following points must be attended to: —

1. Be constantly on guard to prevent refuse or decaying matter of any kind being left in or near the dwelling. If refuse cannot at once be burnt or removed, cover it with quick-lime or kerosene oil. All refuse receptacles must have well-fitting lids.

2. Cover up all food and never let flies alight on food. Use gauze safes or covers.

3. Nail wire gauze over windows and doors especially those of kitchen and dining room.

Remember : no dirt, no flies. Centipedes, beetles and a species of ant help to destroy flies.

The Itch insect burrows into the soft skin between fingers and toes and at the wrists and ankles It has been stated to carry the infection of leprosy. Sulphur ointment well rubbed in will destroy it and this may be repeated several times daily, as necessary, till a cure results. The skin of the part affected should first be thoroughly washed with hot soap and water before rubbing in the sulphur ointment.

Ants may carry the infection of enteric, cholera or dysentery by crawling over food.

Fleas. Baths and change of clothing remove these.* Use Keating's Insect Powder freely on beds and furniture if fleas are troublesome. Wooden floors are their favourite abodes. Cleanliness of the house, and particularly of carpets, rugs, furniture, &c., will do much to prevent this. For rat-fleas use "Pesterine" or else kerosene oil emulsion.

Leeches often get up the nose or into the ears and cause pain and bleeding. Infect *gently* a strong solution of common salt with a syringe up the nose or ear. This will generally make them come away. This should always be done by a doctor, where possible.

Hookworms. These cause *ankylostomiasis,* a disease prevalent in Assam and the Duars, though occurring all over India to a less extent. It is a small white worm, half an inch long. It lives in the human bowel where it only causes symptoms, when present in sufficient numbers. Bloodlessness, indigestion and dropsy are the chief symptoms produced.

The worms' eggs are passed with the fæces of the patient. The eggs grow into larvæ and if these get into water or moist earth they may get into a human being by piercing the skin (especially between the toes) and then burrow their way to the bowel where they grow into the full-grown worm, or ankylostome as it is called. It sucks blood while attached to the inside of the bowel and also irritates the bowel.

To prevent the disease, take care to kill the worm's eggs in human fæces and these should be burnt where possible (or buried at least two feet deep, much less preferably).

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* The objects which serve as seats, clothes, utensils, bedding, carriage, house furniture should be kept as clean as possible.
(*Maha Nirvana Tantra.*)

Care must be taken to prevent the young hookworms piercing the skin of the feet. Boots and socks must be worn and children (who are even more liable than adults to this disease) must not be allowed to run about bare-footed.

Clothing depends on climate and the person's habits. It should be loose and should not check any action of the body. In India, cotton is chiefly worn in hot seasons and wool in cold seasons. Linen, silk, furs, are also used in different places and in cold climates in India. Poor people in India often wear cotton clothes all the year round and put blankets and shawls over these in cold weather but then a flannel under-coat should always be worn as well. Clothing is used to protect the body from heat, cold, wet, dust ; for decency, and for ornament in many cases.

White and grey clothes are much cooler than dark-coloured clothes of the same material. White clothes should be worn while going about in the sunshine.

Clothing should hang from the shoulders or hips as much as possible. It should not press on the chest, belly, waist or indeed be too tight anywhere. If it is, then the organs and muscles cannot work freely. Skirts worn suspended from the hips are often drawn very tightly above the hips and this is injurious. Be careful of dyed cloth as some aniline and other dyes are poisonous.

Clothing should allow air to pass through its pores so that the air next the skin may be changed and purified frequently.

As to corsets (which are not worn by the women of this country but which most Eurasian and European women wear) these if not worn too tight do little harm and are convenient articles of dress. It is the abuse of the corset—by lacing it too tight—that is unhealthy. Corsets for wear in India should be very porous, light, and made of stout

cotton netting with large meshes. They ought to be made so as to rest on the hips.

Waterproofs are worn to keep out rain. They are very hot and keep in the air round the body. They are hence rather unhealthy and should be only worn for a short time when going out of doors in wet weather. They should be ventilated by small holes here and there.

They do not fully protect from heavy, long continued rain.

Cotton and linen get very soon wet with sweat and so one is very apt to get a chill if only wearing linen or cotton clothes. To wear cotton or linen next the skin and then a thin flannel or woollen garment outside is a good plan to follow. Woollen clothes conduct heat badly and so prevent chills. They also absorb sweat and do not get nearly so wet as linen and cotton. Thus they are safer, for the body does not chill so easily. Woollen clothes should be very porous, *light* in weight and of a white or grey colour for India. Thin woollen garments next the skin prevent chills better than any other material. A mixture of silk and wool is very good. Woollen materials are very often made with some cotton in them as this makes them wear longer and helps to prevent shrinking. Linen has no advantages over cotton for garments. Loose clothing is warmer than tight clothing.

In cold climates, leather, sheepskin, furs or thick cloth are worn. The head should be protected from the sun by puggris or solah topis ; and umbrellas should be covered with white covers. Blue or "smoked" spectacles are a great comfort in the glare of the Indian day, and help to protect from sun-stroke.

Clothes that have been worn during the day should be *completely* changed at night. They should be taken out of

the sleeping room, if possible, or else they make the air foul. They should be dried and well aired before being worn again. Never sit or sleep in wet clothes. This brings on fever, dysentery and many other diseases. Night dress should be loose, light and warm to prevent chill. A shawl or *kamarband* should be wrapped lightly round the belly at night. These are not to be recommended for wear during the day. Drawers are better then. Boots and shoes should fit well. The toes and heels should not be too narrow. The soles should be thick enough to keep out damp.

Birth-room. In India it is the custom to have a room in the house set aside for the birth of children. The doors and windows usually are closed up, fires are often lit and no air is admitted for ventilation. The atmosphere is full of poisonous gases and dust. The consequence is that the number of deaths among Indian women in child-bed is enormous. This is due largely to this bad custom of poisoning the woman with foul air. It is also due to the fact that very many of the women are too young to have children. They have not grown sufficiently to be able to be healthy mothers. The large number of children that are born dead or that die soon after birth is also largely due to these causes.

Care of children. In every country many more children die than grown-up people. The chief reason is that most people do not know how to take care of their children. For want of a little knowledge of how it should be guarded from disease the child dies. Most parents do not even understand how a child should be fed or clothed. We often see infants being fed on food which it is utterly impossible for them to digest.

In India this is particularly the case. The mothers in many cases are too young, undeveloped and inexperienced to have children or to be able to look after them.

The health of children is much more easily affected by unhealthy surroundings, unsuitable food and clothing, etc., than is that of grown-up people.

As to food an infant should be fed on nothing but milk till it is 9 months old.

Mother's milk is best of all as we have already seen (see Chapter VI). If a mother cannot suckle her child it is best to get another woman in good health to do so.

If this cannot be done the child may be fed on one part of pure cow's milk* mixed with two parts of water. Mix and boil. Then add a little sugar (milk sugar is best but pure cane sugar will do) and cream. Three or four tablespoonfuls or about one *chitak* of milk should be given every 2 hours for the first two months. The child should be fed once or twice during the night.

During the third month, two chitaks may be given every 3 hours.

When the child is 3 months old and till it is 9 months old give it two parts of cow's milk mixed with one part of water. Feed it every 3 or 4 hours (not now during the night). After the ninth month give a teaspoonful of *atta, soojee*, corn-flour, arrow-root, or ground rice boiled with milk with its meals. Boiled rice may be given in small quantities. After nine months of age a child should thus gradually have its food changed. If it has been suckled by its mother this should usually be stopped when nine months old as after that time the mother's milk becomes too thin and poor for the child.

Rice and milk, *mung dal* and rice, fresh fish, bread (*not chupattis*), and milk are all excellent foods from the ninth

* Where good milk cannot be obtained it is often necessary to resort to tinned milks. These are not as good as fresh milk but are of course preferable to milk of doubtful quality. The "Milk-maid Brand" of Swiss milk can safely be recommended.

or tenth month onward and can gradually be added to as the child becomes older.

Never smear a child's eyes with fat or ghee as is so often done. This brings flies and often causes ophthalmia—a severe inflammation of the eyes with much matter formation, often ending in blindness. At birth, a child's eyes should be gently washed with a piece of soft clean muslin dipped in warm clean water. No soap should ever be used for the eyes. Water should daily be used at all ages for washing the eyes. Grown-up people ought to open the eyes while holding the face under water in a basin for a second or two. This cleans and cools the eyes.

Children are much more liable to chills than grown-up people. The bowels in children most often suffer from inflammation from chills and then the lungs and bronchial tubes. Children should be lightly and sufficiently warmly clothed. A very common cause of illness in infants, especially in hot weather, is too much heavy clothing. Overheating of the body is quite as likely as chilling to upset the digestive organs. More than half the serious illness in children start in some preventable digestive trouble.

Wet clothes should always be quickly changed. Clothes should be kept very clean and dry. A flannel *kammarband* round the belly (not too tight) is very useful. The skin should be washed at least once a day and well dried with a soft cloth.

Children should be taught cleanly habits. They should sleep in rooms which are not overcrowded and should have plenty of air flowing through them. The more a child can be in the open air the stronger it will be. This does not mean exposed to the sun but in verandas and rooms with all doors and windows more or less open during the great heat. When the sun is not so strong, they can play outside. The head requires protection by a suitable covering.

Running about and screaming is very good for children. They expand their lungs and breathe more freely and thus purify their blood better. Plenty of outdoor exercise and games are necessary for a child's health.

The bowels should be moved regularly every morning and it is most important to get the child into regular habits in this matter. The bowels should be moved, or tried to be moved, everyday at the same hour. By doing so, the bowels will learn to act at the time they are expected to. Do not give purgatives often. Fruit, honey and fresh vegetables will help the action of the bowels naturally.

School rooms should be well ventilated, dry, and *have plenty of light.* But the light should fall over the child's shoulders on his book. It should not shine into his eyes.

Many children suffer from weak sight. This should be remedied by spectacles. A doctor should be consulted. The seller of spectacles is not able to correctly tell which spectacles suit a child's sight best.

Badly printed books with too small type should not be used. The eyes should be rested after a few minutes while reading. This can be done by stopping reading and looking at the end of the room for a few seconds.

Children should not be allowed to bend over books while reading or writing. This prevents the lungs and digestive organs from acting freely.

Children should not sit on the ground but should sit on a wooden seat raised some distance from the ground. There should be a support for the child's back which should touch the back below the shoulder-blades. The book (for reading or writing) should not be less than one foot distant from the child's eyes.

When writing, at a desk, the child should bend from the hips but should have his back quite straight. His shoulders should be *parallel* with the edge of the desk. They should

also be of the same height on both sides. If this is not so the backbone tends to grow crooked.

The shoulders should never be pushed up towards the ears, which generally happens when the child rests on his elbows. The fore arms (not the elbows) should be rested on the desk when necessary to do so.

When sitting upright, the child's feet should touch the ground or some foot-rest.

The seat should be at least one foot wide.

Keep the head upright and do not let it sink on the chest.

For writing, the desk should be at about an angle of 35 degrees with the table.

EFFECTS OF EXCESS AND INTEMPERANCE IN THE USES OF TOBACCO, OPIUM AND OTHER ARTICLES OF SIMILAR KIND.

Tobacco is the leaf of a plant which is grown in India and elsewhere. It is smoked or chewed or taken as snuff or with pan (betel).

Tobacco owes its action mainly to one of the most deadly poisons known to us, called *nicotine.* This substance is partly got rid of in smoking but much of this bitter substance collects in the pipe. This is why water is used in *hukas.* The water washes and cools the tobacco smoke. When tobacco smoke is drawn into the lungs its gases are very rapidly absorbed by the blood and tend to poison the heart, eyes, brain, stomach, etc. Small doses of it have a mild poisonous effect and partly dull and paralyse the nervous system and heart. This gives us a languid, lazy feeling and we say it is soothing. It is quite unnecessary that we should use tobacco. It is merely a luxury. *When used too much* it produces very bad sore throats ; the heart acts very irregularly and badly, and breathlessness and severe pain in

the heart follow. The nervous system is dulled, the muscles twitch and the legs and arms become shaky and unfit for fine movements. Blindness may occur. The person looks pale and feeble and flabby. The appetite for food is lost to a great extent. The eyes become red and irritable. Headaches and low spirits are complained of. The teeth become discoloured.

Tobacco has even caused death when smoked or eaten in excess.

Boys think that if they smoke they show that they have become grown-up men. People who see boys smoke only think how foolish they are to do so and certainly do not admire them for doing so.

Smoking in young boys—in fact, until one is about 19 or 20 years of age at least—is a very bad thing. Boys who smoke are poisoning themselves. They get lazy and do not take enough exercise. They have little or no appetite for food. Therefore, their bodies suffer badly from this vice and do not grow well. The fact that so many people smoke does not make it a good thing.

If you do use tobacco, do so in great moderation. Do not begin smoking till you are 19 or 20 at the very earliest.

Two or three pipefuls of tobacco a day should be the limit for health. Cigarettes or cheroots are harmful when smoked in excess and it seems easier or more usual to smoke a large number of them in the day. If people live much in the open air they do not suffer so much from the effects of smoking too much.

Opium is got from poppy-capsules. It is used in India and China as an article of luxury just as tobacco is, except that in China it is more smoked and in India more taken in the solid form. Tobacco is more used in India than opium.

Never give opium to a child to make it sleep or make it quiet. Opium is much more dangerous to children than to

grown-up people. Opium had better never be used except as a medicine. It is used in India by poor people with the idea of keeping off malaria and to lessen fatigue and hunger and to prevent loss of weight. When habitually used in small quantities for such purposes it does practically very little (if any) harm in many cases. But it is quite unnecessary for people who live healthily and get enough good food to eat.

If people take to opium-smoking they get so weak and ill that they lose all control of themselves. They go on drugging themselves with it more and more, and soon become wretched wrecks in body and mind. Such people quickly die from such excess. There is no sadder or more miserable sight than that of a confirmed opium-smoker. Once he has got into the habit of using in excess such a drug he becomes a slave to it. It is only by shutting up such a person and keeping him forcibly from his drug that there is any chance of curing him of this vile habit. Continued opium-eating is not so injurious as opium-smoking. Very many old people in India eat opium in moderately large quantity without apparently causing any serious effect. But the practice is unnecessary in most cases and so is to be discouraged.

Cocaine is a deadly poison got from the coca tree. In India, school boys, students, clerks, and other youths have in many cases taken to the vice of eating cocaine especially mixed with pan. It ruins their health and makes them unfit for any work. When the vice has been acquired, it is, like all other "drug habits," extremely difficult to stop. Cocaine at first stimulates the heart and nervous system. This is then followed by great depression. The person then feels very unhappy and ill. The body and mind both become utterly wrecked and death often results. So grave are the results of this vice that the Government have found

it necessary to stop the sale of cocaine except by licensed druggists.

Indian Hemp is used as *bhang, ganja, charas, majum, sabjee,* etc. These are preparations of the Cannabis Indica or hemp plant.

The most common way to use it is to smoke it but it is also eaten in the form of a sweetmeat (*majum*) or drunk in the form of *sabjee.*

It excites the brain strongly and causes delirium in which state the intoxicated man may commit all sorts of crimes. Murders often occur as the result of quarrels between hemp-smokers. Smoking hemp is one of the commonest causes of insanity in India. Most of the lunatics in Lunatic Asylums in India are stated to be there on account of madness caused by hemp.

Indian Hemp should never be used. It is a poisonous substance whose excessive use can only lead to ill-health, insanity, crime, and unhappiness.

Alcohol is not a necessity except in certain cases of illness. It is merely an article of luxury—an indulgence—in most cases (see also page 86). Small quantities of alcohol do not do much (if any) harm to healthy people who are taking plenty of exercise because they can burn it all out of the body.

"But in him who drinks more than moderately thus much "defect becomes manifest since it diminishes his wisdom, "understanding, intellect,..........and blood. It injuries his "liver and accumulates disease. It diminishes strength and "vigour. The sight of the eye, the hearing of the ear and "the speaking of the tongue become less. That which it is "necessary for him to do remains undone. He sleeps in "uneasiness and rises uncomfortably. And on account of "these contingencies himself, his wife and child, friend and "kindred are distressed and unhappy, and infamy comes to

"his body and wickedness to his soul." (*Dînâ-î-Maînôg-î-Khirad,* a sacred book of the Parsis).

The effects of excess of alcohol are much greater even than this shows. The drunkard becomes subject to diseases which can only be got by alcoholic excess. He is very likely to become insane, he may suffer from incurable liver, kidney, and other diseases brought on by the irritating effect of the alcohol on the brain, liver and kidneys. He becomes unfit for work of all kind. No one will trust him or employ him. He is doomed to poverty and disgrace. His death is often the best thing that can happen to him. The amount of misery in the world caused by excessive alcohol drinking is enormous. The habit of drinking alcohol to excess is easily learnt but is most difficult (if not impossible) to stop. Muhammad, Manu, Buddha and all other great religious teachers saw the utter ruin it brings on people and forbade its use. Modern Science and everyday experience have proved how true is their teaching in this. It is, like opium or cocaine, a good slave but the vilest of masters. Of wine (and gambling) the Koran wisely says : "In both is sin and profit to men but the sin of both is greater than the profit."

Betel (*Pân*) is largely chewed by Indians just as tobacco is. Both pân-chewing and tobacco-chewing are habits which are not necessary and are bad for the teeth. It is the mild stimulation produced by pân that causes it to be chewed. It mildly stimulates the flow of saliva and may help digestion and to remove bad breath and fatigue. It does not appear to be injurious to health when taken in moderation. In excess it upsets digestion and is in such cases a very objectionable habit.

CHAPTER IX.

WASTE AND IMPURITIES.

"What has been defiled by the impure excretions of the body is impure in the highest degree"—(*Institutes of Vishnu*).

Waste substances or refuse are those thrown out from houses as useless—stable litter and dung, ashes, broken pieces of food, bits of rag, paper, leaves, straw, sweepings of floors and gardens, stale fruit and vegetables, etc. It is best to burn such refuse. House yard, compounds and streets should be swept clean of all refuse everyday. Refuse must never be allowed to collect anywhere in or near a dwelling. House refuse should be placed in a dust bin—a wooden or galvanised iron box *with a lid* and which is kept for such refuse alone. Municipal carts with lids on them generally remove this refuse and in the dry season it is burnt in any hollow outside the town (or what is not nearly so good, it is buried). Such burning place should be sufficiently far off to prevent the smoke blowing into the town or village. This refuse may be used as fuel in a furnace or *incinerator.*

In this way fæces, &c., may be burnt by the Municipality of a small town at little cost.

Where refuse cannot be got rid of by burning, see that the pit into which it is thrown is quite dry or a very bad smell and a pest of flies will result. Much earth (or quicklime is better still) should be thrown on the surface of the rubbish or flies will breed there freely.

In Bengal many families live together in one big house often of many floors or storeys one over the other. In the middle of this house there is often a shaft (or passage up and down). Into this remnants of food, bones, decaying fruit and vegetables, etc., are thrown. The result is that these substances poison the air and may lead to serious outbreaks

of disease in the house. This practice brings rats and often plague results.

Refuse should not be used for the purpose of filling up hollow places in the ground. Any places so filled up ("made ground" as it is called) are dangerous sites for houses. Refuse should never on any account be thrown into tanks or rivers.

Impurities. These are spoken of as sewage and consist of the fæces and urine of human beings. Sewage also includes dirty water from baths, from the washing of floors, or of cooking utensils, etc.

The excretions of vegetable-eaters (such as most Indians are) are much bulkier than those of people living on a mixed animal and vegetable diet. On an average most Indian people pass daily solid excretions weighing from 8 to 12 ounces (4 to 6 *chitaks*) and of urine 50 ozs. or about 1½ seers.

These are, as we have seen, the most dangerous matters of all others to health. It must, therefore, be our aim to get rid of these excretions from our dwellings as quickly, as safely, and as thoroughly as possible. No sanitary measure is more necessary than this. Our waste matters, which poisons us and is useless to us, is of much use to the earth. For fæces and urine we have seen make a good manure. Even our waste gases (*e.g.*, carbonic acid) form most necessary food for plants.

In India the methods of **Disposal of Sewage** are, shortly, as follows :—

THE DRY METHOD ALSO CALLED THE CONSERVANCY SYSTEM.

This is the method most used in India. Earthenware or metal buckets or glazed *gumlas* or privy-pans are used into which urine and fæces are passed. The privy pans should never be fixed in the ground so that they cannot be removed and cleaned. In many places the privy pan is placed under

a seat. If there is much distance between the seat and the pan the result is splashing which soils the ground round about. The box which surrounds the *gumla* in such cases ought to be freely ventilated. These pans or *gumlas* are removed by the sweeper to a large vessel into which the contents are emptied. This vessel* should be of iron and should be well scraped and covered inside and outside at least once a week with liquid coal-tar. If this is not done it gets a very strong smell and is dangerous to health. This iron vessel is then emptied into a (Municipal) filth-cart which carries its contents to the trenching-ground where the contents are buried in trenches. Earth is thrown in freely on the contents. These trenches should be a foot wide and a foot deep. They should never be filled more than about one-third of their depth. Then they should be filled up completely with earth and fresh trenches should be dug.

These trenches must be some distance away from the house, village or town and must not be placed near a water-supply such as wells or springs.†

In some places, trenches are dug and the persons use them direct. In this case the trench should be wider (2 feet instead of one foot to prevent the edge of the trench being folded). The trench should be *one foot deep* or birds and other animals may dig up the fæces. But in sandy soil, and

* In villages and small towns wooden or basketwork (lined with clay) receptacles are often used. Iron is much better as it does not absorb filth.

† According to the Hindu Law of Manu, the person should leave his house in the early morning ("bara fajar") taking a bow and arrow with him. When he reaches the outside of his village he is to shoot off an arrow with all strength. Where the arrow falls he empties his bowels and *covers the dejections with dry loose earth*. This for agriculturists is sound advice. But in towns it would hardly do. Imagine the shower of arrows from the dwellers in a crowded street! But the principle laid down by Manu is most excellent. Empty the bowels far away from houses.

"He shall not void excrements on a ploughed field, path, nor in water. He shall void excrements far from his house."—*Apastamba*.

where dust-storms are frequent, the trench should be about two feet deep. Great care must be taken to see that the latrine (or that the out house in which is kept the vessel into which the privy pans are emptied) is not near the dwelling or the cookhouse or well. Of course, the sweeper must never be allowed to throw out the urine or fæces in the compound of the house. Urine especially is apt to be treated thus.

The iron receptacle must be emptied *at least once a day* into the filth-cart. Where there is no cart its contents must be thrown into a trench and well covered with earth. The privy pans, iron receptacles and privy cart must not be cracked or leaky. This is most important.

The privy pans must not be washed with water anywhere except at the iron receptacle, into which the water used for washing should also go.

Servants and the poorer classes generally are very apt to empty their bowels or bladders near their own houses and in this way cause great danger to health.

Trenching grounds must be cultivated and rich crops of jute (in Bengal), cabbages, sugar-cane, mustard, Indian corn, etc., can be grown. This is not only very profitable but it makes the trenches healthy. Potatoes cannot be grown successfully on such ground.

The reason why human excretions are buried is that the earth soon absorbs and destroys all odour. Cholera germs are quickly made harmless when buried in earth. But diarrhœa, dysentery, and enteric fever may be caused if water from a trenching ground gets into wells. Whenever you see swarms of flies at any portion of a trenching ground, you may be sure that it is not being well managed.

The trenching system works badly in the rains. Dry earth cannot be got then and wet earth does not act nearly so well. Besides the rain tends to carry the fæces into

water-supplies then. So trenching grounds require to be carefully chosen. The trenches should be placed well above the level at which any flood can reach them and so wash out their contents.

There should be a belt of trees between them and the village or town if possible. This tends to prevent flies from being blown from the trenches to the village or town. Trenches should be dug parallel to each other. The cultivation of the trenching-ground is a most important matter and unless this is carried out carefully the system does not act well.

People in Indian villages live under the most unhealthy conditions generally. Their excretions are thrown out round about their houses. Their wells are full of filth. The wonder is that they live at all. But the reason is that their bodies have to some extent fitted themselves to resist these germs, as the people have been swallowing and breathing in these germs since birth. When, however, any disease like cholera or plague gets into a village or town like this it finds a very good place to grow. Hence an epidemic breaks out which frequently kills an enormous number of people.

But it must be remembered that the system of sewage disposal must be suited to local circumstances. One method is not equally suitable to different places and conditions.

Other methods of dealing with sewage are :—

The "Wet system." Here the stools are passed into a solution of mercury perchloride (1 in 2000 parts) ; or of cresol (½ oz. to one gallon of water). One pint is placed in the receptacle. The sweeper removes the pan after use and cleans it. The pan is then emptied into the "balti" or pail in which the excreta are removed for burial in trenches. Before replacing the cleaned pan, the sweeper should pour a pint of cresol or of mercury perchloride solution into it.

Urine is passed into *gumlahs* kept separate from those for fæces.

This method is a safer one in general to use than any of the dry methods. The proof that it is being worked well is the absence of flies and of smell.

The *Pail system* is well suited for small towns in India. Here the fæces and urine are collected by sweepers from private houses or public latrines to small depots or centres from which they are carted away by municipal arrangements. Another plan is to use *absorbent* pails in the house to receive the dejections. The pails are lined inside with some material (charcoal, etc.,) which, *when freshly applied,* absorbs and renders comparatively odourless the fæces and urine. This is not a good plan.

The *"Earth closet"* is another variety of the above mentioned system. Here a quantity of dry earth—*taken from the upper layers of the soil*—is thrown on the fæces and urine. This is used in isolated houses and acts well. The earth and dejections are used for manure, or are buried.

The Privy or Midden System. This is still used largely in Indian villages and towns. This method is also very widely used in other countries especially in isolated places where there may be only one or two houses. The excretions are thrown into a large pit which is later filled up with earth. These pits are called *cess-pits* or *cess-pools.* In England in many places the house-drain empties straight into such a pit. This system has suggested the most modern method of sewage-disposal, the Septic Tank system presently to be described. A cess-pit is often the only means of disposing of excretions in houses situated in lonely places. If a cess-pit is used the following points must be most carefully attended to :—

1. The cess-pit must be well-covered so that no smell rises from it.

2. It must be at a sufficiently safe distance from any well, house or road.

3. It should be *water-tight* so that the liquid portion of its contents do not escape into the ground. A brick pit faced with cement will do.

4. It should be ventilated by a double pipe rising a few feet above the ground surface.

5. It should be emptied regularly at intervals and the solid material carted away and buried in trenches. This is necessary for the cess-pit will get filled up otherwise. But if the cess-pit *be sufficiently large* there is no need to clear it out as the sewage will in time purify itself to some extent. A cess-pit which is big enough not to need cleaning out forms a kind of "septic tank" as it is called.

This *Septic Tank System* is the most modern method of sewage disposal. It is a means of working a cess-pit in a thoroughly sanitary way and of preventing all the risks of the cess-pit system.

Here the excretions pass into a closed water-tight tank from which air is excluded as far as possible. If this system is adopted, a plentiful supply of water should be available, for the excretions must be carried by water-flow from a suitable latrine into the closed tank. The tank's size varies, of course, with the latrine accommodation.

The germs which swarm in the fæces become greatly reduced in number and there is reason to believe that no cholera or enteric germ can live long in such a tank. Disease-germs, fortunately for us, are usually much more delicate than many other germs which swarm in fæces, and which attack and kill the disease-germs.

The solid part of the dejection sinks to the foot of the tank and finally becomes nothing but black mud. The liquid portions are allowed to leave the tank and are then purified by filtration and free exposure to the air. Finally,

this fluid has no smell and can be discharged into absorbent waste land far from all houses. It must not on any account be run into any water-supply or into any water which may be used by people for drinking or other purposes.

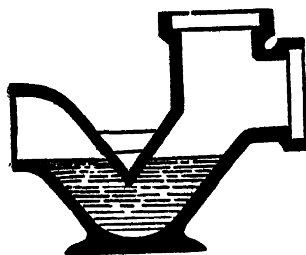
The method is suited for adoption in certain places in India such as mills, factories, barracks, prisons, etc., *where it can be used under good supervision and care.* It is less suitable for large towns such Calcutta, Bombay, etc., for which the system (now to be described) of Water Carriage is preferable. The Septic Tank method is being successfully used in England where, however, the conditions under which it can be worked are very different from those in India. (It is unnecessary in an elementary book like this to give the details of construction and working of such a system which needs skilled engineering advice in each case as suited to the special requirements).

This method has the advantages of not allowing the fæces to be powdered and blown about with dust ; and further the sewage is protected from flies. It is, however, necessary that the fluid finally escaping from the septic tank should be purified by thorough filtration. This fluid *must* not be discharged into any water likely to be used for drinking purposes.

The *Water-Carriage* System is used in India in large towns like Calcutta and Bombay but cannot be used in mofussil places as a rule. It is very expensive to introduce—the cost of building drains, laying pipes, and of working the whole system being much too great for the smaller Indian municipalities. Also because the land is too flat for the sewage to flow along. Thus if this system were used the drains would get quite blocked up and that would be worse than having no drains at all : or pumping would be needed and this is very costly. As it is only used in these large Indian cities and is a method requiring skilled scientific

supervision at all times, it is unnecessary to give a fuller description here than the following :—

This system consists of (1) *water-closets*—that is to say, a pail or trough under a seat. Into this the fæces and urine are passed. Water is then poured in from a small tank which ought to hold at least 2 gallons of water.

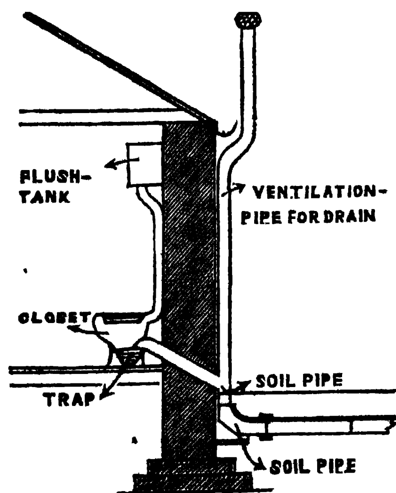


TRAP.

The water washes out the dejections into (2) *a drain* connected with the water closet.

This drain should be made in such a way as to prevent foul gas passing backwards to the water closet.

This is managed by using (3) a *trap*. This, as the diagram shows, is a kind of syphon made by having a bend on the pipe. In this bend there should always be enough water to fill the pipe at the bend. (This is called the water-seal). It prevents gas from the drains passing back into the house. The gases are stopped by the water.



The dejections are carried on past this trap by the rush of water and by syphon-action and pass into the drain. This

then empties (4) into a *sewer* which is a big channel often built of brick and lined with cement so that it is water-tight. This sewer is round or oval and is built underground and either empties into the sea as in Bombay; or into a river; or as in Calcutta into salt water lakes which are many miles below Calcutta.*

These sewers are cleaned out by holes in them into which men go from time to time, and rake out any mud and sludge. These holes are, therefore, called *man-holes* and are to be seen in the middle of those streets under which the sewers run.

The drains and sewers should be well ventilated by pipes. The ventilation pipe of the drains should run up the side of the house away from doors and windows and should open well above the roof. If it has cracks in it gas will escape from this pipe and may get into the house.

Water from baths, rain water from the house-tops and streets, and water used for cooking and other household purposes are also carried off by the drains. This extra water helps to wash the sewage along.

In small towns, villages, factories, jails, hospitals, barracks and other *small* communities the best way to destroy fœces and urine is by burning is an *Incinerator*. This renders the dejections quite harmless. The objection to it is the cost of the Incinerator and of the fuel to keep it working. It is generally too expensive for large towns as it would be difficult to make cheap and good arrangements.

* In flat countries where the slope of the land (or "fall" as it is called) is too small to carry the sewage along, methods of pumping or sucking the sewage along the drains by special machinery is used.

In Calcutta in many of the most expansive houses there is no water closet system at all. The sweeper simply empties the privy pans into the rains direct. This is primitive but has at least the advantage that there is no chance of sewer gas getting into the house through badly trapped drains.

for collecting the sewage and bringing it to the Incinerator. Donaldson's Incinerator is a good pattern for India. Street rubbish should not be burned along with excretions but separately, as a rule. Where Incineration is used constant, responsible supervision is needed. A proper pattern of Incinerator must be used and the staff to work it must be trained to stoke it properly. The fire must blaze and not merely smoulder. Plenty of fuel (the best being either woodshavings or saw dust or coal dust or pine needles) must be used as otherwise the results will be disappointing. A mixing platform for mixing fluid excretions with the fuel is needed and this must be roofed in for wet weather.

There are other means of disposing of sewage by adding chemicals to it ("precipitation method") but the chemicals used make these systems too expensive for poor communities and they have many other disadvantages.

Filtration of sewage through land has been much used in the past. *Irrigation* also is used and by this method the sewage is poured over the surface of the land. These methods are considered unsuitable for most places in India as in dry weather the fæces are powdered and blown about as dust. Besides they are liable to be washed into drinking water supplies during the rains.

Again sewage has been purified by passing electric currents through it. The cost is too great for such a system to be widely used in India.

Latrines should as far as possible be at some distance from a building. There should be a good roof to keep out rain. The latrines should be thoroughly well ventilated by *large* openings near the roof *which should be opposite one another* so that the air may pass straight across the latrine and carry out foul gases. Plenty of *dry earth* should be placed near the privy-pan and a small iron spade should be

used for throwing earth on the motion. Where *gumlahs* have to be used only *glazed gumlahs* should be employed.

Public latrines in India generally consist of a series of compartments in each of which is a *gumlah* placed on the ground inside a matting or corrugated iron screen. These compartments are side by side. Doors should be provided for each compartment for privacy. Water for cleansing the person is brought in *lotahs* by the people using these latrines. This water should always be made to fall into the *gumlah*. In many cases earthen floors exist. This is bad. But if there is no choice, care should be taken that the earth round about the *gumlah* should be loose and absorbent and the sweeper should be made to freely sprinkle a disinfectant solution round the *gumlah* several times a day. Phenyl solution is generally used and does fairly well.

The *gumlahs* should be cleaned by the sweeper *at once* after being used. The latrine should have good cross ventilation. For all latrines a *pucca* floor of brick and cement should always be employed so as to prevent the washings of the person from sinking into and fouling the ground.

Too much water should not be used in cleaning *pucca* floors and walls, for damp latrines always smell badly and attract flies and are altogether more unhealthy.

For large fairs, religious gatherings, *melahs*, etc., trenches are usually used. They should be two feet wide and one foot deep and the length will vary with the number of people who are to use them. They should be well supplied with loose earth to throw on the motion when passed. When one-third full, the trench must be filled up and a fresh trench dug.

Private Privies and Urinals. They should be placed at least 4 feet away from any dwelling-house or business-premises.

They should, if possible, never be placed on the upper

floors of houses. A *pucca* drain must be supplied for each privy or urinal and should open into a municipal drain or sewer where possible.

The floor of the privy or urinal must be made of impervious cement. Glazed tiles (which, however, are expensive) or cement are best. *The floor should be raised at least* 6 *inches above the surface of the ground. The floor must slope towards the drain so as to cause a flow in that direction.*

The privy or urinal must ventilate freely to the open air by large openings near the roof.

Drainage. Damp sites must be drained below the surface by unglazed earthenware pipes or by digging gutters for surface water. These drains must have a proper way of discharging their contents. They should never open into sewers, or gas and germs will pass backwards and poison the soil drained by these pipes, and (through the soil) wells and houses may be poisoned. Rain pipes must be used for carrying off water from roofs so as to prevent damp walls. Often drain pipes run down the outside wall of a house and get broken off several feet from the ground. The consequence is that the walls get very filthy and unhealthy. This is a very common fault in Indian houses. Drains carrying sewage ought not to pass *under* a house for, if they get broken or leak, gases and germs will rise up into the house. *They should run by the side of the house or along the side of the road.* In this way, also, they can be got at easily for repairs. Drains ought to join each other at a sloping or *oblique angle.*

Stables should have *pucca* floors where possible and should be well-drained by a *pucca* drain. The stagnant and putrid water which forms on jheels and other marshy land should be drained by surface-gutters and (if possible also) by subsoil drain-pipes into the nearest river or other running water course.

House drains carrying off water from bathrooms or kitchens or from the roof should end about a foot above the ground and over a grating leading into the ground drain-pipe. In this way gas forced up the ground drain-pipe escapes through the grating into the air comparatively harmlessly. If there was no interval or break, the gas would pass up into the house and poison the people in it.

All inlets into drains should be *outside* a house. [These remarks of course largely apply to those large towns in India where water-carriage and drainage exist].

DISPOSAL OF THE DEAD.

Cremation when properly carried out is the best plan of all. Any disease-germs in the dead body are in this way destroyed. Also the decomposing body is itself got rid of and cannot poison the earth with the foul gases given off by it for so long while decomposing. When the body is buried in the earth germs and gases from it may find their way into wells or houses and spread disease. It has been feared that if cremation were to be adopted widely the bodies of people who had been murdered would be destroyed and the murderers would thus escape detection and punishment. This can be got over to some extent by strict registration of deaths and medical inspection of any body in which the cause of death is not quite clear.

As usually carried out by the poorer classes of Hindus, cremation is not a good plan of disposal of the dead. For, as often carried out, it is only cremation in name. Often the dead Hindu is taken to the burning *ghat* and his face merely burnt with fire. Then his body is thrown into the river when the dangers to others are obvious enough.

Again the body may not be burnt thoroughly because of the poverty of the relatives or the greed or dishonesty of the

people who are paid to burn the dead. But when a body is *completely* burnt there is no doubt that this is the best way of all. *Fire is our most greatest natural cleanser.* Nothing is as good. We purify our food and our drink by fire. We burn all infected articles. Therefore, we are right in burning our dead and thus getting rid of the dangers arising from their bodies.

Christians and Muhammadans from long-established custom or for sentimental or religious reasons prefer to bury their dead. Indian Muhammadans seldom use a coffin. The body is wrapped up in clothes and so buried. This is a good plan, for the decomposition of the body is thus not delayed.

The grave ought, where possible, to be made in a *dry and porous soil.* Clay soil is bad as it is not dry or porous. Gravels are too loose and should never be used. Sandy mould or loam is preferable where there is a choice of sites.

Four feet of soil *at least* should cover a grown-up person. 3 feet is enough to cover a child under 12 years of age. Two coffins buried in the same or adjacent graves should not be less than one foot apart. The graves should not be re-opened for several years, if possible. If the body is buried *deeper than* six feet decomposition is less rapid.

Bodies should not be buried within stone or brick walls unless there is the risk of the bodies being dug up by animals. Lead or thick wooden coffins are bad as retarding decomposition. Basketwork coffins are best because most porous.

The burial ground should be some distance away from a town or village. It should be as far as possible from wells or other water supplies. Burial grounds should therefore not be made on high ground whence drainage may occur towards wells or houses. They must not be placed where they may be flooded or washed out by a river or stream's

encroachment. As regards the space necessary for a burial ground, an acre of ground for each 1000 of population (for fifty years) is recommended for general guidance.

Trees, grass and plants should be planted as they dry the soil and purify it to some extent. Disease-germs, ***with a few exceptions***, are rapidly killed by burial.

Quicklime is often used. The body is surrounded with it. Quicklime rapidly destroys the soft tissues of the body and thus hastens decomposition, and the splitting up of the tissues into their elements. The quicklime also helps to absorb the foul gases given off.

In India bodies should be buried deep enough to prevent jackals, pariah dogs and other animals from digging them up and feeding on them. Heavy flat stones may have to be placed under the surface of the ground to prevent this. It is for the reason that bodies are often buried in a space surrounded by stones or bricks which thus protect the body. This delays decomposition but is much more sanitary and seemly than having the body dug up by these foul animals. The burial-places need frequent inspection by the authorities in charge of them to prevent such desecration of the dead and the resulting danger to the public health.

The Parsi method of exposing dead bodies to be eaten by vultures has never been proved to carry disease or to be in any way insanitary. The body in about a week—often within 2 or 3 hours—is picked of all flesh and the dry bones are then cast into a large pit where they gradually crumble to dust. In Bombay the *Dakhmas* or "Towers of Silence" are very carefully looked after. The places on which the bodies are laid are lined with marble and cement. Any fluid which escapes is carefully disposed of. This method of disposal of the dead is rapid and effectual. It is for these reasons better than earth burial.

Animal carcasses are in India often allowed to lie

unburied. This is not only disgusting but most unhealthy. Dead bodies of horses, oxen, dogs, goats, etc., should be buried or, better still, burnt. The body if to be buried should be carted away by sweepers and buried far away from wells or houses.

Dead rats should be burnt (See Plague, Chapter VII). Dead bodies of any kind should of course never be thrown into rivers, tanks, and disused wells.

Diseases connected with filth. All infectious diseases flourish best in filthy surroundings. Cholera, plague, enteric fever, and dysentery are particularly dependent on filthy surroundings. Such diseases as small-pox, diphtheria, anthrax, relapsing fever, influenza, plague, and infectious pneumonia become much more fatal and spread much more widely in filthy surroundings.

Worms, itch and a parasitic skin-disease which causes ring-like, red eruptions on the skin called ring-worm and dhobi's itch (got from dhobis with this disease having touched clothes) are caused by filthy habits or surroundings and general want of proper cleanliness. Many other skin diseases are also caused in this way.

Women who have just borne a child are very often killed by dirty surroundings. A fever called "child-bed fever" or *puerperal fever,* attacks them and nearly always kills. It is caused by want of personal cleanliness ; also by shutting the woman up in rooms without free ventilation and from which the air is carefully kept out ; also by dirty bedding, clothes, furniture, etc., or latrines or dirty surroundings of a like nature. This disease never occurs except through dirt.

Sufficient has already been said in other chapters to show how all-important is cleanliness as regards the body and its surroundings.

Offensive Trades. Foul slaughter-houses are most unhealthy to a neighbourhood. All such trades should be carried on some distance from towns or dwellings. Markets (bazars) may be dangerous to health through accumulation of filth, fragments of decaying animal and vegetable matter, etc.

Where horses, cows, pigs are kept in a filthy and insanitary state it is punishable by law as a nuisance and danger to the public health.

Such trades as boiling bones, soap, blood, trip ; or fat or tallow melting ; manure manufacturing ; glue-making ; cattle-slaughtering ; hide-dressing ; collecting refuse and rags for paper-making ; tanning leather may cause danger to health. They may do so by poisoning the air or by causing such foul smells that people close their doors and windows to keep out the stench. This also keeps out fresh air and so the ventilation of houses near these trade premises becomes very bad. They may also be dangerous from the refuse thrown out round about the works or poured into rivers thus fouling the water.

Badly smoking factory chimneys are similarly a nuisance for the reason above given.

Laws exist in most civilised countries to control these trades and to give powers to stop, if necessary, dangerous and offensive trades from being carried on.

FINAL REMARKS.

Duties of the citizens as regards Sanitation. It is the duty of every sensible and humane man to do his best to lessen the amount of preventible suffering in the world. By even taking care of his own health and of that of his household he is doing much towards this end. One house in a good sanitary condition is one less for an epidemic to fix on.

On the other hand, one man's carelessness or neglect may cause an epidemic. Think of how much pain and suffering this causes to other people.

Therefore, keep your house clean and do all you know to keep your household free from disease. How this is to be done the foregoing pages have tried to show in some measure. Every good citizen should not only keep his own household in such a condition that the inmates remain healthy. But if he sees any danger to health outside his house in the village or town or other place in which he lives— he should try to get this remedied. The attention of the health authorities may be drawn to the matter; or by private influence or advice he may be able to get the person who is responsible for some unhealthy condition to remedy it. Every educated man ought to try to show the absurdity of the "kismat" doctrine.

"Weak-minded persons sit idly waiting for some gift of fate."—(*Hitopodesa*).

Men can and do alter circumstances every day and so they alter Fate. For instance, the stools of a cholera patient are thrown into a well. Is a man to drink that well-water and to trust to *kismat* not to get cholera? If the well is closed or thoroughly cleaned out we know for certain that cholera cannot be spread by means of *its* water at least. By taking proper precautions, then, Fate *can* be averted.

It is the duty, then, of all educated men to use their knowledge for the benefit of their fellowmen.

"High-minded men delight in doing good without a thought of their own interest."—(*Mahabharata*).

Every one who has been taught Hygiene can do something to lessen insanitary surroundings or to prevent the spread of disease. If everyone tries to do his best in his way and shows other people what they should do in the same way, much good must certainly result. Health and

happiness would come to many people who otherwise would suffer from quite preventable causes and die long before they ought to in the course of Nature.

APPENDIX I.

Physical Exercises : --

The following exercises should be practised on rising every morning. They should be done in the open air or before an open window.

Think of every movement while doing it. Breathe in through the nose ; and out through the mouth.

1. *Deep Breathing.*—This is of the utmost importance to health. Suck air through the nostrils (with the mouth closed) until your lower ribs swell out as far as possible. Then, ***without a pause,*** breathe slowy out by the mouth and draw in the belly so as to squeeze all the air out. Then repeat. Do this twelve times. Repeat as often as you can during the day-time if in the open air.

2. *Exercises for Arms, Chest and Neck.*—(*a*) Stand upright. Heels close. Head erect. Chin slightly drawn in. Then (*b*) bend to the front with the arms (with back of hands touching) stretched downwards. Keep the back straight, and the belly drawn in. Breathe out.

(*c*) Raise the hands slowly above the head and lean back as far as you can. Draw in your breath through the nostrils. Then lower arms to the side. Repeat the whole exercise several times.

3. *To strengthen the belly-walls and stomach.*—(*a*) Stand upright as before. Stretch the arms out straight in front. Then slowly swing round on the hips to the left as far as you can, without lowering the arms below the level of the sholders and without moving the feet from the first position.

(*b*) Then swing slowly round the opposite way (to the right) as far as you can. Breathe in when going round to the left. Breathe out when swinging round to the right. Repeat the whole exercise twelve times.

4. *For the Back and Belly muscles.*—(*a*) Stand upright as before. Stretch hands above the head till they meet. Then lean back as far as you can and draw in a breath. Then (*b*) swing round to the front ***so that the hands describe a circle in the air.*** Breathe out when at the front of the circle. Move from the hips but do not move the feet from the starting position.

5. *For the thigh and belly muscles.*—(*a*) Stand upright *but with feet apart.* Reach up with the hands over the head as high as you can. Breathe in. (*b*) Then slowly bend down in front till you touch your toes (or your shins if you cannot reach the toes at first) Breathe out when touching the toes (or shins).

6. *For all the leg muscles.*—(*a*) Stand upright as before. Then place your hands on the hips. Stand on tip-toe. Turn the knees outwards. Then (*b*) bend them slowly down until you are in a squatting position. *Keep the heels off the ground all the time.* Breathe out as the body goes down to the squatting posture.

(*c*) Then slowly rise up until you are in the position (*a*) from which you started. While rising up, breathe in. Keep the belly and small of the back drawn in while doing this exercise.

In every Exercise, remember the following :—

Do not overtire yourself. Rest a few seconds between each exercise for the first few days. And increase very slowly the number of times you do each exercise until you reach the limit of twelve times for each exercise.

APPENDIX II.

I

WELLS—

1. Is it a shaft without any masonry, commonly called a "kutcha well ?"

2. Or of pucka brick without lime mortar ?

3. Or pucka brick with lime mortar ?

4. Is there any ridge to prevent spilled water from falling back into the well ?

5. Is there a masonry platform around the well to throw off the water which spilled during drawing ablutions, etc., and thus prevent it from immediately trickling down and returning to the well ?

6. Give the diameter of the platform, and state if there is any drain in or around it to carry off the water.

7. State when the well last dried up, or when the supply was so much diminished that it became dry in the middle of the day.

8. Does the depth of water in the well diminish very much during hot dry months ?

9. Describe the method of drawing water.

10. State when the well was last cleaned.

11. Is the well covered in so as to exclude dust leaves, etc., and if so, in what way ?

12. By whom is the water used, and for what purposes ?

13. State the opinions of those using the water as to its purity, wholesomeness, etc.

14. Note the proximity of

(*a*) Any dwelling-houses, barracks, cook-houses, latrines or privies or urinals, and state their distance from the well.

(*b*) Also of any trees, or accumulation of refuse matter, filth, mud, water, or manure.

15. Note also the existence of any depressions (in which water is liable to lodge), ponds, tanks, drains, water-courses or rivers in the vicinity, and give their respective distances from the well.

16. In case the well water is found unfit for use, can it be filled up with earth ?

II

TANKS—

1. Give the measurement of the long and short side, or, if square, of one side, and also the depth in centre.

2. Are the sides of the tank of earth or of pucca masonry ?

3. Note the presence or absence of water-plants.

4. If present, state their nature.

5. Note the presence or absence of fish.

6. How is the supply of water maintained ? By a spring or by rain-water flowing from the adjacent land ?

7. Is the supply of water in the tank perennial and does it continue good throughout the year ?

8. State the purposes for which the water is used *viz.*, for ablution and washing clothes, or for drinking or culinary purposes, or for all.

9. Are cattle bathed or watered in the tank, and is jute, sunn, or any other fibrous product steeped or washed in it ?

10. State the opinions of those using the water of this tank, regarding its purity, wholesomeness, etc.

11. By whom is the water used ?

12. Note the proximity of any dwelling-houses, cattle sheds, latrines, large trees, accumulations of refuse matters, filth, manure and state their distance.

13. Do any drains open into the tank ? If so, to how far from it do they extend ? Do they run in the neighbourhood of any bazar or other possible source of pollution ?

14. Will these be any difficulty in carrying out any suggestions for the improvement of the supply which may be made by the Sanitary Commissioner.

III

RIVERS—

1. State the name of the river.

2. Is it tidal or otherwise ?

3. What is the average depth of the water at the time of report ?

4. Note the distance from any native city at which the water on which you are reporting was drawn, and whether it was taken from above the city or below it.

5. By whom and for what purposes is the water of the river used ?

6. Is suspended matter present in large amount, and is it allowed to subside before using, or is the water usually drunk in the same condition in which it is drawn.

7. State the opinion of those using this water regarding its purity, wholesomeness, etc

8. Is the water equally good throughout the year ?

9 Are the banks polluted by the people ? Do house drains, kitchen refuse, and ditch water enter above the place from which this specimen of water was taken ?

10. Would there be any difficulty in carrying out any suggestions for the improvement of the supply which may be made by the Sanitary Commissioner ?

APPENDIX III.

Rates of stomach-digestibility of foods :—

The following foods have been experimentally proved to have passed *out of the stomach* of average, healthy persons in the times mentioned :—

Raw *beaten-up* egg, ¾ hour.

Raw egg or well-soaked rice, 1 hour.

Plaice (fish), 1½ hours. Minced, undercooked steak, 1¾ hours (if well-done steak, 2½ hours).

Boiled sago, or pilan of rice, 1¾ hours.

Fried fresh egg; or boiled milk, or rice or tapioca pudding, 2 hours.

Raw milk, 2¼ hours. Cream cheese or " bortsch " soup; or raw oysters; or caramel custard pudding, or junket (curdled milk), 2½ hours.

Roast sirloin of lamb or venison; soft-boiled hen's egg; or fresh bacon; or boiled sole (fish); or boiled maize, 2¾ hours.

Boiled chicken or mutton, or floury, well-boiled potato; or omlette (of eggs); or white bread, 3 hours.

Stewed sweetbreads; or thin brown bread and butter; or steamed artichokes; or mashed turnips; or asparagus with melted butter; or camembert cheese, 3½ hours.

Roast fowl; or boiled cabbage; or vegetable stew with peas and beans; or roast veal; or bread and vegetable soup; or a meal of thin bread and butter, with cold roast beef and tea; or boiled duck; or roast lamb, 4 hours.

Ham, 4½ hours. Suet dumpling, 4¾ hours. Plum pudding with brandy sauce, 5½ hours. Meal of bread and butter, underdone steak and ale 4¾ hours. Scraped ham with toast and barley water, 3½ hours. Meal of boiled plaice, roast meat, fruit jelly and banana, with ½ pint claret, 5½ hours. A four course vegetable meal, 6½ hours.

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Printed and published by J. C. Ghosh at the Cotton Press, 57 Harrison Road, Calcutta, for Messrs S. K. Lahiri & Co.—24-10-1929—xx.